City, County and State

APR 13 1934

PUBLIC WORKS

Sewerage and Sewage Treatment | **Highways and Streets** | **Water Supply Refuse Disposal** | **Construction and Engineering**

APRIL, 1934

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PUBLIC WORKS

Vol. 65 No. 4

CITY, COUNTY AND STATE ENGINEERING AND CONSTRUCTION

TABLE OF CONTENTS FOR APRIL, 1934

TIMEWASTERS

The principal assistant Timewaster is greatly disturbed over an influx of letters from indignant folk asking what sort of a system it is that has 11 digits in it. It seems that the wheel illustrated in the March issue had 11 different letters, and therefor, in the minds of many, should have eleven digits in the answer. Bob Clark, the uncle of this, is rusticating among the snow banks of Kenmore, and we have not been able to find out whether this was a misprint, or malice aforethought.

However, Don Hastings of Detroit comes across with the following:

A	B	C	D	E	F	G	H	I	K	and	O
2	9	3	8	1	5	7	4	6	0		8

Many of our friends sidestepped this and merely relieved our mental anguish about dividing a circle into 14 sectors. Two good solutions are: By Mr. Hastings: "One-fourteenth of the circumference of a circle is 25° 42′ 51 3/7″. The sine of this angle is 0.433883". Sounds fine. Thank you, Mr. Hastings. And now, from Walter Wheeler: "Mark off 9/10 of the radius from the center and erect a perpendicular. Where that intersects the circle—there you are." Thanks again.

Question?

Are the Timewasters getting too hard for Mr. Average Citizen? Let's have a vote. Mr. Hastings sends in one of those far-famed killiloo bird problems which we'll save for next month pending the returns from the vote. In the meantime, here are a couple of easy ones, including our old friends Ikey and Mikey again.

A Land Tax:

R. N. Clark says Mikey and Ikey are in trouble again. Each bought a square piece of land, but Ikey's piece was smaller than Mikey's, being one rod shorter on each side. So to equalize matters Ikey decided to buy more land, and bought a strip along two sides of his square, the width of which was the square root of the difference in area of the two squares. Then he found that his new square was too large—he had purchased 5.8 times as much land as was needed to make the two areas equal. How much land did Ikey have originally and how much should he have bought?

Mr. Clark also sends another digit transposition problem. A number consists of three digits. Increasing this number by ⅓ of its own value we have the same three digits; and increasing this second number by ⅓ of its value, the third number consists of the same three digits.

For the Surveyors:

Mr. Corson sends in another that looks good. "Recently I was requested to lay out an octagon, each side of which was 8 feet long. I had no tables or books, or any instrument other than a 50-foot tape. In a few minutes, I worked out the radius, and the center being given, the rest was easy. How would you do it?"

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A. PRESCOTT FOLWELL, *Editor* W. A. HARDENBERGH, *Asso. Editor*

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FOUNDED IN 1896

Pages 53, 60 and 61 contain descriptions of many helpful booklets—Don't forget to look them over.

PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 65 — *April, 1934* — No. 4

School Days for Township Commissioners

By Wm. W. Reeder

Assistant Engineer, Bureau of Public Works, Upper Darby Township, Pa.

"Township Commissioners Go to School Again" was the headline which greeted the readers of one of the local papers in Upper Darby Township, Pa., in February of 1932. The school for employees of the Department of Public Works had recently been organized by Samuel H. Walker, highway commissioner, and the first meetings of the class had been so successful that members of the Board of Commissioners had decided to take advantage of the course.

Upper Darby Township, in Delaware County, is the largest first class township in Pennsylvania. It has 26 miles of storm sewers, 106 miles of sanitary sewers, and 135 miles of roads, of which 110 miles are hard surfaced. The principal activities of the Department of Public Works are highway construction and maintenance, storm and sanitary sewage disposal, and street cleaning. It was Mr. Walker's thought that instruction in the reasons for the use of certain materials and the proper methods of using them would be reflected in the quality of work produced. The results have been far greater than anticipated.

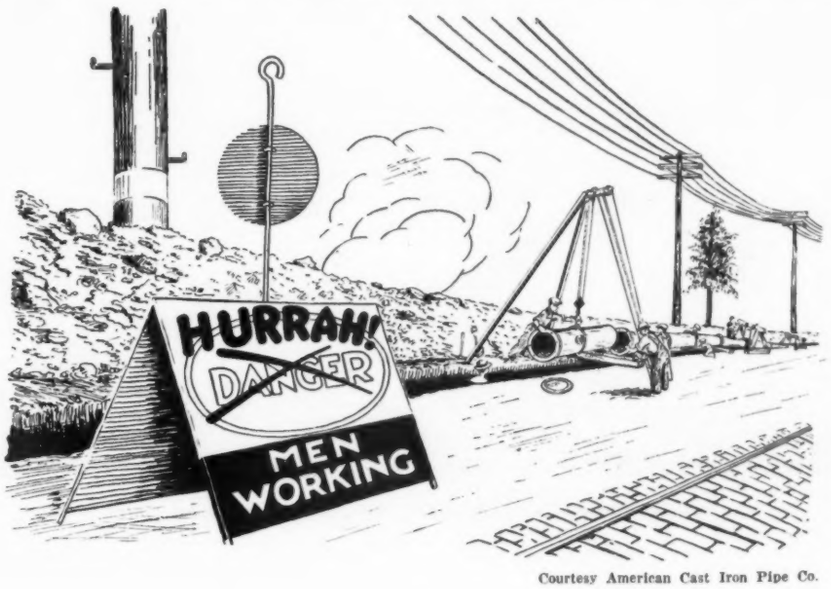
The preparation of lectures for such a mixed class, ranging as it did from Italian laborers to successful business men of the community, necessarily presented difficulties. The township engineer and his assistant, who give the talks, realized that the material had to be instructive without being too technical. With this in mind, the first sessions were devoted to elementary discussion. "Asphalt and Its Uses" was one of the first subjects. The Asphalt Institute furnished a lecturer for one of the meetings and supplied a hand-book on asphalt to each member of the class. This service is available to similar groups.

The Portland Cement Association loaned motion-picture films showing concrete highway construction and the manufacture of cement. They also had a representative give a series of three demonstrations of water ratios in concrete. The various batches were mixed right in the classroom and the calculations shown on a blackboard. Splendid results were achieved by these demonstrations and the blackboard became an important part of all subsequent lectures. One evening was given over to elementary surveying and plan reading; others to sewage disposal and treatment. An attempt is made to select such subjects as will tie-in with the work with which the men are engaged at the time the talks are given. After each lecture the men are encouraged to ask questions, and the discussion often lasts an hour or more.

At the close of each meeting, one of the commissioners speaks on some detail of the township government, such as tax rates, pending bond issues, budget control, etc. This proves valuable, as municipal employees are in a position to spread a vast amount of mis-information unless in possession of the correct facts.

Detailed minutes are kept of each meeting and mimeographed copies are available to all members of the class. Each session opens with roll call and the average attendance is over ninety per cent of all employees. Meetings are held at least once a month, and at times every two weeks.

These meetings have held the interest and attention of the men. The educational feature has been but a part of their value. The men have grown to know their superiors and each other better. There is greater harmony and team-work evident. The men take a pride in their work, and the marked increase in efficiency and morale evident since the class started is, in a large measure, attributable to the information and inspiration received by attending the meetings.



Courtesy American Cast Iron Pipe Co.

Sewage Disposal at Fort Atkinson, Wisconsin

An activated sludge plant with separate digestion, gas utilized to drive generators, and tanks heated by engine exhaust; of compact and economical design.

By Robert Cramer

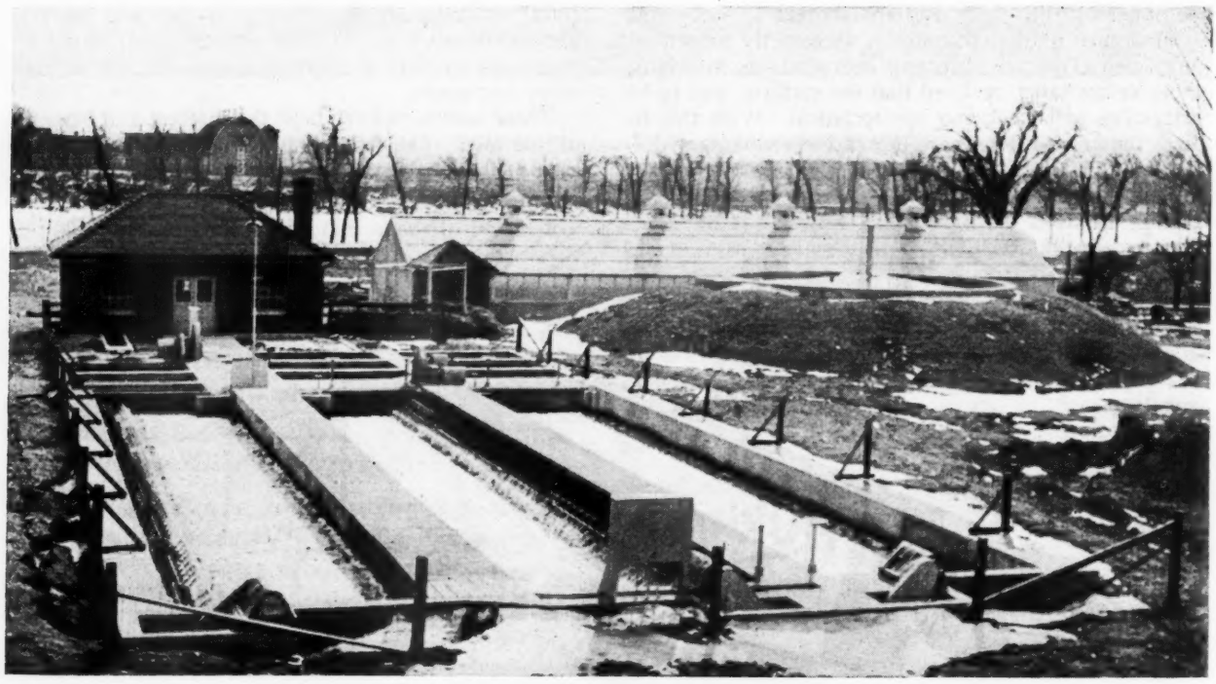
ON February 3, 1934, the new sewage disposal plant at Fort Atkinson, Wisconsin, was officially opened in the presence of James L. Ferebee, Federal State Engineer of the Public Works Administration, members of the City Council, and representatives of the State Board of Health. This plant, the construction of which was partly financed with the aid of a Federal grant, was the first PWA project finished in the state of Wisconsin.

The Fort Atkinson sewage disposal plant represents the city's share of the Rock river clean-up program formulated by the State Board of Health. All the liquid waste produced in the city, domestic sewage as well as industrial waste, is gathered in a recently completed sanitary sewer system and conveyed to the plant, which is located about 1200 feet west of the city limits. The sewage is not mixed with storm water, which is taken care of by a separate system. Industrial wastes are contributed by a slaughter house and a sausage factory, and by several machinery manufacturing plants. A vegetable canning plant, handling mostly peas, is operated during a short season, lasting only eighteen days (usually from June 16 to July 4), but during this time the additional water and organic matter discharged into the sewer system is very large, increasing the average normal sewage flow by about 35%, and more than doubling the organic matter entering the disposal plant. At the present time the sewage flow averages about 420,000 gallons per day, the flow during the day being at the rate of 0.6 mgd. and during the night about 0.2 mgd.

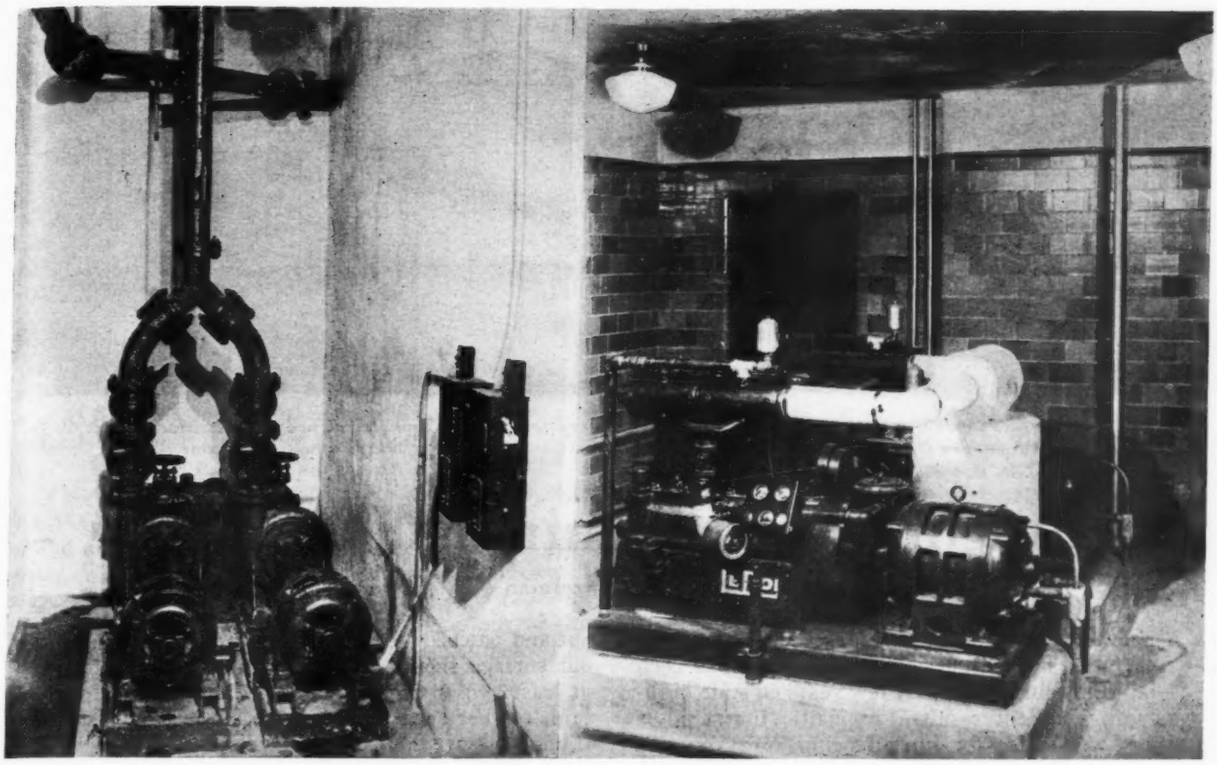
In designing the plant, sufficient capacity was provided to treat 50% more than the present sewage flow, thus providing for the estimated growth of the city for the next 25 years. At the present time the additional capacity is expected to take care of the additional waste coming from the vegetable canning factory during the 18 days of its operation. It is also expected that as the city grows, separate facilities for the treatment of this waste must be provided.

When considering the purpose of the plant with reference to the Rock river clean-up program, it was decided that complete treatment should be provided and that the most suitable type of final treatment would be the activated sludge process. The treatment in the plant consists of coarse screening, primary settling, aeration with activated sludge, and final settling. The settling tanks are of the rectangular type, equipped with Jeffrey sludge collectors. Mechanical aeration only is used and is accomplished by means of "Straightline" aerators made by the Link Belt Company. From the final settling tanks the effluent passes through a sewer directly into the Rock river.

The sludge collected in the final settling tanks is discharged from the sludge hoppers through four adjustable draw-offs into a channel leading to the suction well of two centrifugal return sludge pumps, one of which is in continuous operation. The return sludge pump characteristic is such that it automatically takes care of the return sludge under any adjustment of the draw-offs. The variation of the amount of sludge accumulated in the suction well, without permitting the well to empty or overflow, changes the head against which the pump



General view of Fort Atkinson, Wis., sewage treatment plant



Left: Return Sludge Pumps; right, Sewage Gas Engine Generator Sets and Exhaust Gas Heater

operates so that the quantity pumped varies from zero to the full capacity. Thus the rate of pumpage always equals the amount of sludge drawn off.

The return sludge pump delivers the sludge into a division box from which, by a simple adjustment, any proportion of the sludge can be diverted into the return sludge pipe entering the aeration tank. The balance is wasted to the digester.

The digester is equipped with a Downes floating cover. The gas generated is delivered through a flame and relief trap to the service building.

A unique feature of the plant is the arrangement for the most economical utilization of this gas. Two gas engine generators are installed in the service building. Only one of these is to be operated continuously, so that the other one can always be shut down for cleaning, adjustment, or repairs. The gas engines drive induction generators which float on the line of the public service current supply. By means of a special gas holder which serves as a regulator, the engine is so governed that all the gas generated is used up for the generation of power and only the balance needed is furnished from the public service. It is expected that normally the gas produced will be sufficient to furnish about two-thirds of the total power required for the operation of the disposal plant.

The engine exhaust is used to heat circulating water which is continuously forced through heating coils installed in the digester. A thermostatically operated valve admits cold water to this circulating system when the temperature in the digester tends to exceed the optimum of 85° F. When this occurs a corresponding amount of hot water is wasted through an overflow pipe from the expansion tank of the circulating system.

The circulating pipe is so arranged that it can also be connected to hot water radiators in the service building and to a coal-fired heater which is used when the heat obtained from the exhaust is insufficient to keep the digester at the optimum temperature. It is expected that the latter condition will occur only during prolonged cold spells, which happen occasionally during severe Wisconsin winters.

The digested sludge is discharged from the bottom of the digester onto sludge-drying beds provided with a cover made of corrugated wire glass which is strong enough to make hail insurance unnecessary. The glass cover is provided with side ventilating sash and automatic ventilators at the ridge of the roof. This arrangement makes it possible to discharge digested sludge onto the beds at any time, independent of the weather. The drain from the sludge-drying beds is discharged into the plant influent.

The supernatent liquor from the digester is passed through a tank in which it is freed from surplus ammonia and albuminoid nitrogen by treatment with lime, and is then drained into the plant effluent.

The service building, which contains three sewage lifting pumps, the return sludge pump, the two gas engine generators, a switch board, transformer room, flame and relief trap, coal-fired heater and circulating pump, laboratory and office, and operator's wash room, is so arranged that no sewage is exposed in the building. The building is thus entirely odorless.

The three sewage-lifting pumps are of different capacity and are automatically controlled by a Cutler-Hammer float switch which successively puts them into operation in seven different combinations, thereby gradually varying the pumpage by equal increments.

The plant was designed by Robert Cramer & Sons, consulting engineers, Milwaukee. The construction work was done under a general contract by Fluor Brothers & Smith, of Oshkosh, Wisconsin.

Badly pot-holed surface-treated street treated with 20 lb. cold patch and 80 lb. hot surfacing

Very rough sheet asphalt patched and resurfaced with 60 lb. of cold lay asphaltic limestone

Salvaging Old Bituminous Pavements

By J. H. Conzelman

AS a low-cost method of salvaging old bituminous surfaces, fluxed limestone rock asphalt has been laid thin during the past few years on state highways, with excellent results. Asphaltic limestone is peculiarly well suited for thin surfacing, for it contains innumerable pores filled with native bitumen which are exposed in the faces of the crushed particles and provide better adhesion, or bond, with the added fluxing asphalt used in the mixture than can be secured with the usual paving aggregates, which results in a tough mixture very little affected by the deteriorating action of the elements and traffic.

Both hot and cold-laid asphaltic limestone have been used on thin resurfacing work. When the resurfacing is to be laid less than one inch thick (or 100 pounds per square yard), the cold-laid asphaltic limestone is preferable because of the added time it allows for manipulation in laying. The same grading of pulverized rock asphalt is used for both hot and cold mix. A typical screen test of the pulverized rock asphalt is:

	Per Cent
Passing 200 mesh sieve	13
Passing 80 mesh sieve	10
Passing 40 mesh sieve	16
Passing 10 mesh sieve	30
Passing 4 mesh sieve	24
Passing 2 mesh sieve	7

Thin asphaltic limestone surfaces have been laid on bituminous streets that need re-sealing; streets that are rough because of shoving, base settlements or wear; bituminous surface treatment that require excessive maintenance; badly cracked and weathered old surfaces that ordinarily would be taken up and new surface laid; in fact, on any old bituminous surface, which has a stable foundation that requires smoothing up or re-sealing. Birmingham, Ala., has used 60 lb. per sq. yard. laid cold on a very rough asphalt pavement; on another very rough one, 20 lb. cold for patching followed by a surface of hot mix. Meridian, Miss., used 20 lb. of cold mix patching, surfaced with 60 lb. of hot mix in one street and 80 lbs. on another.

On work of this character the old surface should be cleaned and any high spots or defective base areas cut out and patched. Depressions and irregularities in the old surface should be patched and brought to grade at least two or three days before the thin surfacing is laid, so that such areas can be subjected to sufficient traffic to assure their thorough compaction. Any irregularities missed during the first patching, or settlements in such patching, may be brought to grade and compacted by tamping or rolling just ahead of spreading.

The patched surface should be painted with cutback asphalt or asphalt emulsion sufficiently in advance of spreading the new material to assure a good sticky surface. An asphaltic limestone requires only a light paint coat—one gallon of paint to 15 or 20 square yards being sufficient. The resurfacing is then shoveled and raked into place, care being taken to break up any compacted pieces and spread the material to an even loose consistency. Five-foot to six-foot lutes are very useful in getting an even, true surface on these thin jobs.

One difficulty in laying any thin bituminous mixture is in truing up the old surface sufficiently and spreading the new material evenly enough to assure thorough compaction under the roller to all areas of the new surface. Bridged spots show up after the first rolling and may easily be corrected where a cold-lay asphaltic limestone is being used. One effective method is to screen out the 15 to 20% of larger particles in the mixture and screed or lute from 6 to 8 pounds per square yard of the remaining fine material over the surface directly after the first rolling.

For thin seal coat work, the cold-lay asphaltic limestone is most satisfactory because of the ease with which it can be manipulated and handled in patching the old surface and laying the new cover. Where as much as an inch thickness of new surface can be used, patching is often done with the cold-lay mixture and the new surface laid with hot mix.

The work done with these materials to date indicates that old bituminous street and road surfaces that have reached the point where riding qualities or maintenance require relaying can, with moderate expenditures, be satisfactorily renewed and placed in condition to give many years of economic service.

Determining the pH of Sewage Sludge

By Morrill Dakin

Chemist, Sewage Treatment Works, Dayton, O.

AT DAYTON, Ohio, samples of Imhoff sludge for analysis have been taken in three different ways: from the riser in the sludge box; by the use of a pitcher pump on the end of a hose let down through the gas dome; and by means of a stoppered bottle lowered through the slots, the stopper being pulled after the bottle has reached the sludge level. Numerous determinations on these samples fail to indicate that any one method of sampling is better than another.

Preparing the Sample

If sludge is allowed to settle for a short while, sufficient supernatant liquor will form at the top to be removed for pH reading. The main objection to this method lies in the fact that the surface of the liquid may gain or lose gases to such extent as to change the pH value of the supernatant liquor removed. If the sample is to be run immediately, then some method of rapid clarification is needed.

Ordinary hospital absorbent cotton has been used as a filtering medium and two sets of samples have been put through it; one set just as the sludge was drawn, and a second set in which the sludge was diluted 10 to 1 with water of pH 7.0. The results obtained indicate that Imhoff sludge is a sufficiently good buffer to allow a dilution as described without changing the pH value of the filtrate. It is interesting to note that values obtained by filtration have been in accord with those obtained by using supernatant liquor.

Imhoff sludge may be sufficiently well clarified by centrifuge for colorimetric determination. Values received from this liquid correspond to those obtained by the previous methods.

If Imhoff sludge is placed directly on a No. 1 Whatman filter paper in a Buchner funnel and the filtrate collected, the pH of this liquid is found to be three to four-tenths of a pH unit higher than samples of any of the foregoing methods. Occasionally one of these samples runs as high as eight-tenths above the previous reading. Dilution of the sludge previous to filtering through paper does not materially change the pH and shows again that Imhoff sludge acts as a good buffer when the dilution is no greater than 10 to 1.

Water of pH 7.0 has been subjected to the various methods of preparing sludge. The first 25.0 cc. portion of water through cotton gave 6.6. Each succeeding portion of water gave an increased pH value until after about six washings 6.9 was reached. Further washing did not increase the pH value.

This same water centrifuged gave a reading of 7.1.

Neutral water was filtered several times through No. 1 Whatman in a Buchner funnel and each time the fitrate showed a pH of 7.0.

Methods of Determining pH

The foregoing results have all been determined colorimetrically using colored glass standards (Hellige Klett). Our laboratory has used various methods and we believe such standards to be satisfactory.

The set of liquid standards employed faded perceptibly within a year, and unless they were handled with great care became easily broken.

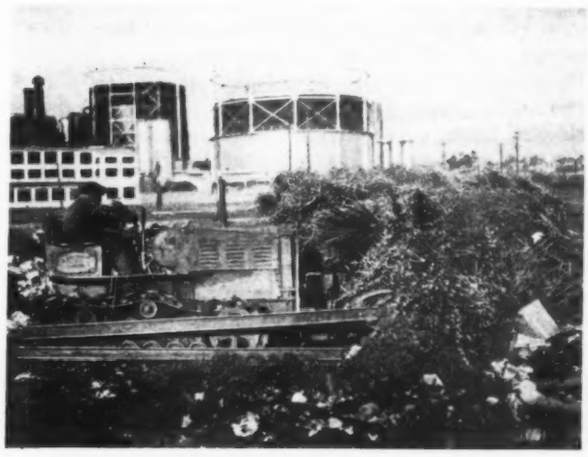
The potentiometric method using quinhydrone has been tried with varying degrees of success. If straight sludge is used, the gold electrode becomes greasy and inaccurate readings are obtained. If the sludge is diluted 10 to 1, the value received is generally two-tenths of a pH unit higher than cotton filtered sludge.

The Wulff apparatus in which the indicator has been incorporated in a gelatine slip does not give very satisfactory results. Sludge adhering to the slip must be either rinsed or blotted off, and a range of two-tenths

Controlling a City Dump

San Diego, California, Disposal Department uses a Cletrac 15 and bulldozer to handle all refuse at the city dump. The tractor helps to unload the trucks and then spreads the material. It handles an average of 80 tons of material a day. Garbage, tin cans, bottles, wire bed springs, and other rubbish are quickly and economically handled. The clean-cut construction of the tractor, which has no projecting parts to catch pieces of rubbish is an important feature in this work.

Prevention of nuisance when garbage is dumped requires prompt spreading and a good cover of inorganic material. For such work, the bulldozer is very valuable.



difference may be noted on the same gelatine slip during a determination. The general color of the slip changes toward higher values as the slip is being watched while reading its value.

Lastly there is the electrometric method, using the hydrogen electrode. It takes considerable bubbling of hydrogen to saturate the platinum electrode, and by the time this is accomplished all gases such as NH_3 and CO_2 have been removed by the hydrogen, thus changing the sample.

Comments

In the determination of the pH of sludge, various questions arise. Some are of a general nature and some are peculiar to the Dayton plant or type of plant. Generally speaking, the most natural question is, "Which is the most accurate method of pH determination?"

During the operation of the plant at Dayton, a period of three years, our laboratory has made the pH determination of sludge by the approved dilution-cotton filter-colorimetric method. In this time and out of about 3000 sludge samples per year, we have gotten only an occasional alkaline or even neutral pH value. Since January 1, 1932, the Imhoff sludge has had a maximum pH of 6.9, a minimum of 6.5, and an average of 6.6. It has been generally understood that acid digestion gives large quantities of CO_2 and correspondingly small quantities of methane. Gas analyses made once per week since January 1, 1932, give an average of 19.6% CO_2, which is not high, and 66.9% methane, which is not low. It seems from the above that either the method of determining pH of sludge is wrong and gives us too low a figure or else that a satisfactory methane and carbon dioxide ratio may be had under acid conditions.

Further, it is shown by analyses at Dayton that incoming sewage is alkaline with a pH averaging 7.7 and that the effluent from the Imhoff tank is also alkaline with a pH averaging 7.5, but that fresh solids settling a distance of 15 feet, as the sewage crosses the tank, are acid with a pH of 6.6 if a cotton filtrate is used, or 6.8 to 6.9 if a paper filtrate is used. The question arises as to whether the solids are actually on the acid side and, if so, what causes the rapid change.

One theory sets forth the belief that the solids in sewage are of one pH value and the liquid another. There is no doubt but that samples filtered through paper are much clearer than samples prepared in any other way. Whether removal of low pH solids is the reason for high pH filtrate is a question.

The above was given by Mr. Dakin as a discussion of a paper by James R. Collier, superintendent of the Elyria, O., Sewage Treatment Works, before the Ohio Conference on Sewage Treatment. In his paper Mr. Collier said: "At the individual sewage plant a certain sludge pH may be indicative of impending foaming, or another pH indicative of an optimum condition of sludge digestion. It is impossible, however, to associate the same pH with the same condition at all plants and, more unfortunate still, it is quite probable that, even at the same plant, the significance of pH may vary for certain reasons or perhaps for no apparent reason at all. . . . It seems that pH at best can be termed only indicative of conditions when applied to sludge control, since no definite and inflexible relationship between the two can be shown. In other instances, however, pH does have a definite value. Activated sludge at Milwaukee is most efficiently dewatered only when the pH has been adjusted to around 3.4. Similarly, pH control may be used with good results in the conditioning of digested sludge for more rapid dewatering on filter beds."

House Drainage in England

House drains in England are installed according to either a one-pipe or two-pipe system. The former is opposed by conservatives, although it is the one in practically universal use in this country. In the two-pipe system, water closets and other fixtures receiving excretal matters are connected to one soil pipe, and all other fixtures to an entirely separate waste pipe. The former pipe, provided with a deep-seal trap, leads directly to the sewer. The latter discharges into a trapped gully supposed to absolutely prevent the passage of air from sewer to waste pipe. All fixtures connected to the soil pipe are trapped and the traps ventilated; while those connected to the waste pipe are not trapped, and the regulations for construction for both waste pipe and fixtures are not so rigid. A committee of the London County Council has recommended that it adopt standard regulations permitting the use of the one-pipe system, under requirements as to traps, etc., which represent common practice in the United States.

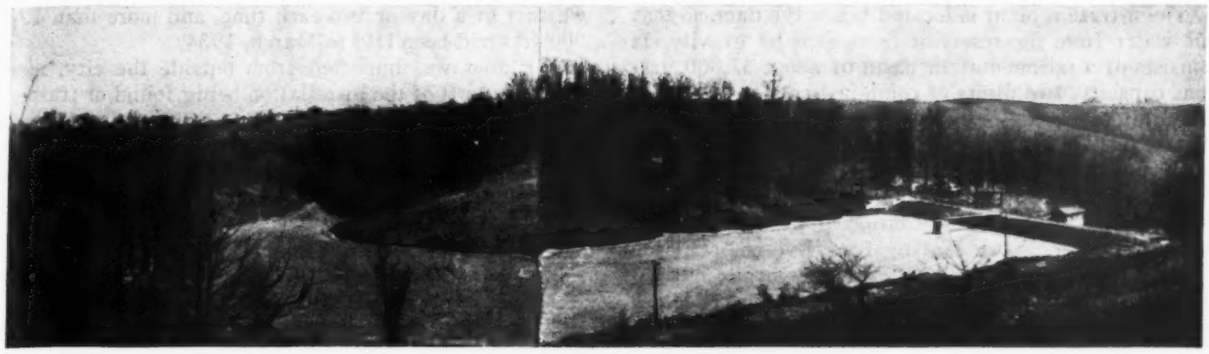
The English "gully" would never be tolerated in this country, although it has for 25 years or more resisted efforts by a few English sanitarians to dislodge it. W. H.Scanlan on March 5th, in a paper before the Chartered Surveyors' Institution, said: "Until a few years ago the practice was for the waste to discharge into the gully over the grating, either direct or by means of a channel. It is now permitted in most districts to enter the gully under the grating. I suggest its purpose is to prevent solids entering the drain or to provide a grease trap. The effect of this is to cause an accumulation of foul matter disintegrating usually under a window, with the result that objectionable gases rise up the waste pipe and, where fittings are improperly trapped, in the building. . . . In the majority of cases gullies rarely receive the periodic cleansing and flushing that is required, and the concrete surround usually provides defects where filth accumulates and percolation has been found to exist into the surrounding ground."

In short, every house is required to maintain an individual septic tank in its yard.

Roadside Beautification in Ohio

"The highway beautification program of the Ohio State Highway Department will get under way in full swing with the advent of favorable weather," reported Dallas D. Dupre, Jr., state landscaping engineer, on March 10th. "Work on projects has already started in Highway Division No. 12, including Cuyahoga county; Division No. 4, comprising Lake, Geauga, Summit, Portage, Stark, Ashtabula, Trumbull and Mahoning counties; and in Division No. 5, consisting of Knox, Licking, Fairfield, Coshocton, Muskingum, Perry and Guernsey counties

"Plans have been practically completed on the number of projects throughout the 12 highway divisions which it will be possible to complete during the Spring months. The projects are allocated from three to seven in a division, depending upon the size of the individual projects."



Panoramic view of Owenton reservoir and dam

Design of Small Water Works Plant at Owenton, Ky.

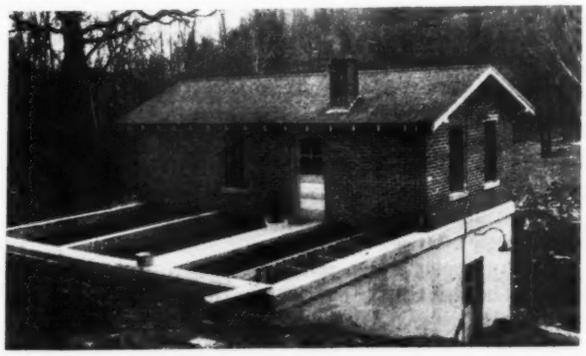
By C. N. Harrub

Consulting Engineer, Nashville, Tenn.

THE town of Owenton, Kentucky, has felt the need of an adequate water works system for several years, but until government aid, through the Reconstruction Finance Corporation, was made available, it was unable to finance the project. In the Fall of 1932 the mayor and council decided to avail themselves of the opportunity offered by the Government, and to this end employed the writer's firm to make investigations, surveys, and to prepare estimates of cost and an application to the Reconstruction Finance Corporation for a loan. This application was submitted to the R.F.C. early in November, 1932. Approval of the loan was made by the R.F.C. on March 30, 1933.

The project was advertised, and bids for construction were received on May 12, 1933, and formal contracts for construction were executed under date of June 12, 1933, subject to the approval of the Reconstruction Finance Corporation. These contracts were all approved and funds made available so that actual construction was begun on July 17, 1933. The plant has just been completed and accepted by the mayor and city council.

The plant consists of an earth dam and impounding reservoir, filtration plant, force main from the plant to town, distribution system and elevated storage tank.



Filtration plant and pumping station

On account of the fact that the town is located on the top of a ridge, there is no stream of sufficient size within reasonable distance from which a water supply could be obtained. Consequently it was necessary either to get water from wells or to build a dam and impound a supply. The history of wells in this section has not been such as to give any hope of deriving a sufficient quantity of satisfactory quality from this source, and so investigations of the possibilities of a surface supply were made. Several dam sites were found where sufficient water shed was available, but some were not considered on account of the drainage from the town. Three sites were studied thoroughly for drainage area, availability of dam site and height of dam required to provide the necessary storage. Two of these were found satisfactory, one about 0.8 miles from town and the other 1.25 miles. Fortunately the one nearer town could be built for less money than the other, and this site was selected.

The dam is 35 feet high and about 300 feet long, and contains 12,750 cubic yards of fill. The gate house is located about midway of the dam near its upstream toe, and is provided with gates to permit taking water from two levels. There is also provided a 24 in. drain line with gate in the gate house, by which the reservoir can be entirely drained. The dam backs the water up the valley for half a mile when filled to a depth of thirty feet at the dam, and will store approximately 25 million gallons above the twelve foot stage, which is low-water elevation, which will provide for 120 days' supply without any inflow, allowing for seepage and evaporation.

At one end of the dam is a concrete spillway of sufficient capacity to pass the entire runoff from the most severe rainfall of record in this vicinity. This spillway is built in the original ground and not in the fill, to avoid any settling. On account of the steep slope of the hillside it was necessary to construct a masonry flume from the spillway to the bed of the original stream to avoid wash. This flume is made of native rock laid in mortar, and is stepped to break the flow.

The filtration plant is located below the dam, so that the water from the reservoir flows to it by gravity. It consists of a sedimentation basin of about 37,000 gallons capacity, two filters of combined capacity of 240,000 gallons per day, and a clearwater basin of about 31,000 gallons capacity. The water level in the settling basin and filters is controlled by a float valve in the filter building. The coagulant is applied in the float valve chamber, where the agitation mixes it thoroughly with the water. After leaving the valve chamber the water passes through an over-and-under baffle chamber and thence to the settling basin, at the far end of which it is collected over a skimming weir and conducted to the filters.

The pumps which deliver the water to the town are located on the same floor as the pipe gallery. Two pumps are provided, each with a capacity of 250 g.p.m., designed to operate against a total dynamic head of 350 feet. This capacity is considerably in excess of the rate of use, but is provided in order to get the best possible insurance rating.

The force main is of 8″ centrifugal cast pipe and is about a mile long. The distribution system consists of about three and one-half miles of centrifugal cast pipe ranging from 8″ to 2″ in size. There are 28 fire hydrants in the system, so located as to furnish fire protection to every house in the town.

The tank is located near the center of town at practically the highest point in town. It is 24 feet deep and is elevated on a 100 foot tower, thus giving a good pressure all over town.

The cost of the project, subdivided into principal items, was as follows:

Dam and gate house	$13,017.88
Filtration plant and pump station	10,977.82
Distribution system	28,490.94
Elevated tank	4,616.92
Miscellaneous construction, roads, etc.	1,565.73
Real estate, rights of way, etc.	1,914.50
Total, including engineering, legal, administration and interest during construction	$60,583.79

The entire work of design and supervision of construction was handled by the writer's firm, The C. N. Harrub Engineering Company, with M. U. Snoderly as resident engineer on construction. The dam, filtration plant and distribution system were constructed by the Knight Engineering Company, general contractors, of Louisville, Kentucky, and the elevated tank was furnished and erected by the R. D. Cole Manufacturing Company of Newnan, Georgia.

Insurance Savings from Water Improvements Will Retire Bonds

Wheaton, Ill., population about 7,000, has a water system which includes 63 miles of mains, only 7% of which are smaller than 6-inch. To improve pressure, the council decided to install a belt line of larger pipe around the business district and extending into the residence district. In the Fall of 1932, the desirability of giving work to the city's unemployed and the low prices of material decided the council to begin this work, and it has been laying a 12-inch line since October of that year. The first order for pipe, 100 tons of Mono-cast pipe, was received early in October, and work has continued with only two interruptions for bad weather of a day or two each time, and more than 13,000 feet had been laid to March, 1934.

No labor was imported from outside the city, men for every part of the installation being found or trained from the city's unemployed, using 180 heads of families who supported 632 citizens. These citizens have received $17,000 in wages and another $2,500 has been spent locally for materials; while $20,500 has been spent outside the city.

No taxes or assessments have been levied for this improvement, but $40,000 of bonds, to be retired during a 20-year period from earnings of the water department, were issued and bought by the city from funds available. The Illinois Inspection Bureau has, because of the added fire protection afforded by this improvement, changed the city's rating from seventh to sixth class, which will make a direct saving to the citizens of from $2,500 to $2,800. This alone is sufficient to retire the bonds and pay more than 2% interest on the cost.

Chlorine Reduces Grease Skimmings Odor

Odor from Grease Skimmings produced a pronounced nuisance at the Erie, Pa., treatment plant, where the skimmings were piped into a concentrating tank in the incinerator building. The superintendent believes that "decomposing skimmings produce some of the most foul and obnoxious odors that are encountered about a treatment plant." Use of H. T. H. effected a decided improvement, but the remedy finally decided on was chlorination by means of a M.S.P. type chlorinator. The chlorine is introduced into the concentrating tank at the discharge end of the influent line. Complete success requires about 1.4 p.p.m. residual chlorine, the amount necessary varying with the temperature of the liquor rather than with the amount of grease and scum. With an average flow of skimmings liquor of 5,000 g.p.d. and skimmings varying from 3.8 to 11.0 cu. ft. per day, the city used an average of 1.5 lbs. of chlorine per day costing about 11 cts.

Activated Sludge Treatment Impaired by Stale Return Sludge

"The rate and degree of purification through an activated sludge plant may be decidedly impaired by concentration of the return sludge in the final settling tank sumps. This concentration allows the sludge to grow stale at a rapid rate. Even moderate deviation of the sludge from its original condition by virtue of short concentrations greatly reduces the rate of purification through the aerators. The effect of this stale return sludge is most important on plants with comparatively short detention periods." The efficiency of the process "may be impaired as much as 30 per cent under normal operating conditions." A concentration ratio of 2.5 to 3 has proved satisfactory for normal operating requirements at the plant where these studies were made.

The decreased efficiency may be due to the fact that increased demand for oxygen of staler sludges exceeds the available oxygen supply, and because the presence of toxic substances formed in the staler sludges delays the activities of the organisms effective in purification, the latter probably being the greater factor.

This subject was discussed at some length by G. M. Ridenour and C. N. Henderson in a paper in "Sewage Works Journal," from which the above was quoted and abstracted.

Highway Research Summaries

Briefs of Some of the Reports Presented at the 13th Annual Meeting of the Highway Research Board

The Economy of Highway Improvements

Professor H. B. Shaw, North Carolina State College

In estimating the economy of contemplated road improvements, the question, "How much can we afford to invest now to save a determined amount of annual expense?" can be answered by comparing the additional investment with the saving in cost which it effects.

This method of computing economy is illustrated in detail by a project for improving a gravel road by surfacing it with concrete. For the cost data assumed, it is shown that the improvement is justified for an annual traffic of 200,000 vehicles or more, but that for 100,000 vehicles it does not appear to be economical; also that the saving in annual road cost is relatively small in comparison with the saving in vehicle operating cost when the annual traffic is large. Indeed, an approximate economy determination can be made by considering the vehicle cost only.

* * *

Report on Curing of Concrete Pavements

F. C. Lang, Chairman

This report summarizes the information concerning various factors of the curing problem that has become available in the last two years. The results of studies on the following topics are presented: (1) The factors that influence the efficiency of sodium silicate surface curing. Data from experimental projects in Missouri and Louisiana are included. (2) The factors that influence the efficiency of integral calcium chloride as a curing agent. This covers recent experimental work, reviews of published data and the work of a fellowship at the U. S. Bureau of Standards. (3) Bituminous Curing Agents. A study of conditions which may obviate the tendency of pavements cured with bituminous coatings toward more shrinkage cracks than in the case of those cured with wet earth; also the effect upon volume change and shrinkage cracks of covering the bituminous coatings with a whitewash or light colored powder.

* * *

The Engineering Valuation of Highway Systems

Anson Marston, Senior Dean of Engineering, Iowa State College

The highway systems constitute a public utility comparable to the railways and surpassing all other utilities in magnitude of investment, yet highway engineers do not know how to ascertain the correct present values of the highway properties nor have they developed any standard system of accountancy.

The same general principles of valuation and accountancy developed for other public utilities apply to highway valuation, including the rule that all factors affecting value must be given due consideration and a weight which is just as determined by judgment, not by formula.

The physical value of the system may be determined by: (1) valuing the land owned and used; (2) determining the original cost new less depreciation; (3) determining reproduction cost less depreciation; giving such weight as is just to original cost and reproduction cost price levels. Allowance for preliminary expense and going concern intangible values are matters for research and discussion, as is also the working capital of highway systems.

The earning values of highway systems can be determined by analyzing the revenues (from property taxes, license fees and fuel taxes), operation costs and annual "actual" depreciation costs.

The service-worth values are what their earning values would be if their revenues were just equal to the "reasonable worths" of their total highway services rendered. Traffic surveys and research on reasonable worths of different highway services are necessary to determine true service worth values.

A standard accountancy system should provide for depreciation accountancy and include property ledger sheets kept up to date. Depreciation of the various property units and/or age groups of like units should be estimated by modern methods.

* * *

Sub-Committee Report on Maintenance of Concrete Pavement Cracks and Expansion Joints

W. H. Root, Iowa Highway Commission

This report is a record of the conditions of application and results secured with various fillers on three experimental road sections in Iowa. In 1931 five asphalts, three tars, one asphalt cut back and one asphalt emulsion were tried on one road. In 1932 materials similar to the more successful asphalts and tars used in 1931 and a heavier cut back asphalt were used on two other roads.

The cut back and the emulsion used in 1931 gave some trouble in application and neither appeared to solidify rapidly enough to be considered satisfactory for use under traffic. The heavier emulsion gave satisfaction although it was difficult to apply.

The asphalts with penetration around 100 at 25° C. and fairly soft tars with a float test around 112 gave good results.

The results of similar experiments in California and Connecticut are to be reported later.

* * *

Sub-Committee Report on Maintenance Costs

H. K. Bishop, U. S. Bureau of Public Roads

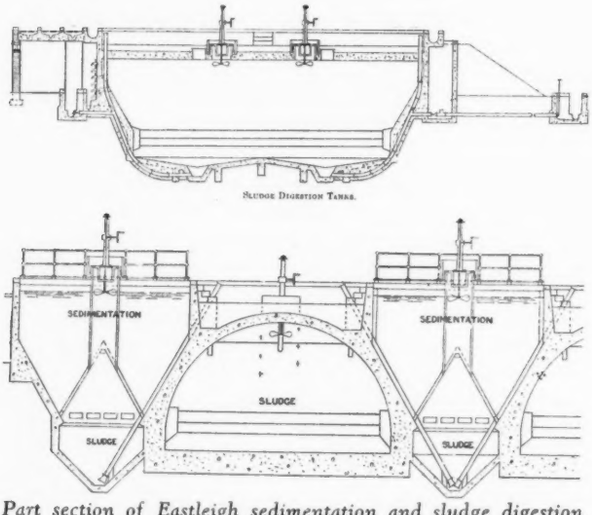
The Bureau of Public Roads is making arrangements for comparative maintenance cost studies on selected sections of modern highways in the various states. Thus far twenty-seven states have started the study, two have selected sections for approval and thirteen have signified their probable cooperation. The twenty-nine states have selected sections consisting of the following surfaces: Concrete, 3,968 miles; Brick, 142 miles; Bituminous, 1,838 miles; Oil Processed, 1,283 miles; Surface Treated, 1,092 miles; Untreated Stone, Gravel, Sand-Clay, etc., 2,205 miles; Topsoil, 133 miles; Graded, 59 miles.

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

The Digestion Tank

TREATMENT of Toronto, Canada, sewage[M4-1] recommended: Racks, grit chambers, preliminary sedimentation, aeration, final sedimentation; sludge digestion and dewatering. Capacity 157.5 m.g.d. Automatic raking of racks, screenings burned in gas-fired incinerator. Preliminary sedimentation, 2 hr. detention (48 min. during storms). Detention in aeration tanks 5.5 hr.; spiral flow, bottom diffuser plates. Detention in final sedimentation tanks, 2.9 hr., 650 g.p.d. per sq. ft. Surplus sludge returned to sedimentation tanks, Detention in digestion tanks, 50 days; heated to 80° to 85°. Gas used for incinerating screenings and heating tanks and plant. Sludge chemically conditioned and dewatered on vacuum filters. Estimated cost, $9,435,000.

Sewage treatment trend was forecast by a British engineer, who admitted that his ideas were "purely visionary."[D4-4] He visualized the substitution for sewerage systems of individual "puritoriums," one in each building, where "solids can be incinerated or heated. digested and disposed of in an inodorous and unobjectionable form, and liquids can be treated by immediate filtration and by the utilization of chemicals and pure water." It would "in an automatic, fool-proof, reliable and inodorous manner, treat the sewage and discharge gas," which can be used or dispersed; solid matter, unobjectionable and inodorous, which can be incinerated, removed with the domestic refuse, or placed on land; and liquid, which can be run into street gutters. With these in use, public sewers and disposal plants, with their enormous costs, would gradually go out of use. The author admitted this was far in the future, and the "automatic fool-proof" part would seem to be especially so; but—who knows? With mechanical, physical and chemical processes replacing bacterial ones it may yet come to pass; and with sanitary sewers eliminated, our rivers and lakes may again become clear and unpolluted.



Part section of Eastleigh sedimentation and sludge digestion tanks. Above, longitudinal section of digestion tank.

Digestion tanks and sedimentation tanks, united, are used at Eastleigh, England[D4-11], preceded by air-agitated grease interceptor and followed by coke and gravel filters. Digestion tanks are two-story, upper compartment 10,000 cu. ft. capacity, lower compartment, 3,360 cu. ft., with slots between (similar to Imhoff tanks). Digestion tanks between sedimention tanks, filled from latter by hydrostatic pressure forcing sludge through sloping sludge pipes, 4 pipes to each tank. Digestion tanks, capacity 14,800 cu. ft., kept constantly full. Gas collectors at tops of both sedimentation and digestion tanks, each provided with a hand-operated scum stirrer to facilitate passage of gas into collecting domes. Digestion tanks heated by hot-water pipes around the inside, utilizing exhaust waste gases and circulating water of engines operated by sludge gas. Two primary digestion tanks and two secondary; sludge pumped from former to latter.

Activated sludge treatment of Washington, D. C., sewage is proposed by a recent report.[E4-1] Capacity for 1950, 130 m.g.d. Summer treatment: grit chambers, grease separating tanks, preliminary sedimentation, aeration, final settling; sludge digestion, conditioning and dewatering. In winter, aeration omitted, final settling tanks used as plain sedimentation. In summer, river is low and 90% removal of B.O.D. desired and 98% of bacteria; in winter 33% removal of B.O.D. and 50% of suspended solids sufficient. Detention in preliminary tanks 1.5 h. in summer, 4.5 hr. in winter (assisted by final settling tanks). Aeration tanks, 5.5 hr. detention, including 25% return sludge. Final settling tanks, 800 g.p.d. per sq. ft., detention period 2.5 hrs. Sludge tanks capacity, 4.6 cu. ft. per capita.

Eight multiple grit chambers to keep velocity at 1 ft. per sec. Aerated grease-separating tanks, 4 min. detention. Aeration tanks 375 ft. long, spiral flow, bottom diffuser plates. Digestion gas used in two 1200 hp. gas engines to drive pumps, blowers, etc. Digested sludge mixed with twice its volume of clean water and agitated with compressed air, to settle in tanks, be filtered on drum vacuum filters, and dewatered cake be used on 2700 acres of land owned by D. C., park lands, etc. Overflows from digestion and sludge conditioning tanks, and excess activated sludge, returned to preliminary sedimentation tanks. Estimated cost: construction, $7,900,000; operation, $390,000 per year.

Circulating sludge in a digestion tank is recommended by Pruss[G4-3], to be performed by a pump invented by him, pumping sludge to the top of the tank for one hour daily, and scum to the bottom for another hour; claiming that thereby the quantity of gas developed is doubled and twice as much material digested, and scum difficulties practically eliminated. Baltimore installed a Pruss pump in 1932 (costing $1,080) and

tested it for a year, from which it was concluded that: "1—Sludge digestion was not accelerated. 2—The solid content in the ripe sludge withdrawn was much less. 3—The liquefaction of solids was one-half as great. 4—Considerably more digested sludge and correspondingly less supernatant liquor was withdrawn. 5—The solid content in the sludge throughout the main portion of the tank was less. Although the difference was not great, it was sufficient to create quite a difference in volume of sludge drawn. 6—There was less scum formation. 7—The heat losses from the tank were no greater. 8—There was no increase in the percentage of volatile solids in the ripe sludge withdrawn. 9—There was only a slight increase in the content of carbon dioxide in the gas. 10—The total gas production was increased 21%.

"It would seem that a sewage works provided with sludge tanks containing Pruss equipment would have to have considerably more sludge drying facilities than a plant where such equipment was not used," but less supernatant liquor to dispose of.

Large sludge digestion tanks have been built at Essen-Nord, Germany.[H4-1] Each is 58 ft. deep and 52.5 ft. diameter, the top tapering to 23 ft., and has a capacity of 77,600 cu. ft. The greater part of the height extends above the surface of the ground. Heating units are suspended from the top and can be lifted out when desired. Fresh solids are introduced at the top near the side and are mixed with the ripe sludge by means of a Pruss screw mixer, run 3 min. every half hour. Due to the tapering top, the scum is concentrated on a relatively small area, allowing the spray of the mixer to cover the whole surface and the gas is collected in a smaller space. Two of these huge tanks cost far less than six of equivalent combined capacity, two are easier to control, the operation is simpler, there is less damage of upsetting the digestion activities, and the equipment is simplified.

Dr. Pruss has designed a digestion tank for Hullerbach 130 to 160 ft. diameter and 33 ft. deep, the bottom containing four concentric troughs acting as hoppers. A revolving top carries sludge-drawing pipes, heating units and mixing pumps, which can thus be placed anywhere in tank.

Pipes used for heating the digestion tanks of the Essen-Rellinghausen plant pass directly from the air into the sludge and have corroded entirely through at the surface of the sludge.

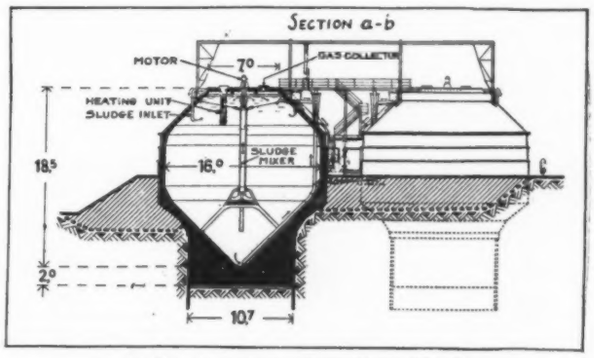
Ferric hydroxide, producing a clear effluent and 60% reduction in B.O.D., has been produced electrically in Germany[H4-1] by electrolysis of iron electrodes. Dr. Jung claimed that "50 ppm. of iron could be precipitated electrically at about 10% of the cost as compared with ferric chloride and that the electricity could be produced by generators and gas engines operating on the gas from sludge digestion. The major cost, aside from labor, would be the cost of the iron electrodes and a small amount of air used for mixing and oxidizing the ferrous to ferric hydroxide." Dr. Rudolfs thinks "the method may have specific interest where the sewage contains large quantities of dyes, or when dye wastes alone are to be treated, but is unsuitable for domestic sewage."

Nitrogen as free ammonia will be found in a well modified sewage (one that has been given so-called complete treatment) in amounts of not to exceed 5 ppm.; and the total nitrogen content, including the free ammonia, probably will be under 10 ppm.[BB4-4] "Whether it is right or wrong to state that the nitrogen determinations indicate the strength of sewage in respect to its odor-producing qualities I am not positive."

pH at best can be termed only indicative of conditions when applied to sludge control, since no definite or inflexible relationship between the two can be shown.[BB4-5] "Opinions of the foremost authorities are at variance as to the pH range indicative of an optimum condition of sludge digestion. . . . The value of the application of pH to the control of sludge digestion appears, at this time, to be somewhat overestimated." At the Columbus experimental plant, when ferric chloride is used in conditioning sludge, no relation has been found to exist between the per cent of conditioner added and the pH. Morril Dakin says that the effluent from the Imhoff tank has a pH averaging 7.5, but fresh solids settling in this tank have a pH of 6.6 if a cotton filtrate is used or 6.8 to 6.9 if a paper filtrate is used. "One theory sets forth the belief that the solids in sewage are of one pH value and the liquid another."

Vacuum filtering and incineration of sludge are being investigated in an experimental plant at Chicago.[BB4-3] Sludge is being filtered as fresh as possible (septic sludge does not filter well) temporary excesses in quantity being digested and digested sludge mixed with the raw. Mixed primary and activated sludges settle to a 95% water content, 4% to 6% by weight of ferric chloride is added, and the sludge filtered to about 78% moisture, and dried in rotary driers to about 15% moisture, then fed to an incinerator. This incinerator contains overlapping grates and bars which oscillate back and forth to avoid the formation of clinkers. Chain grates failed because of the clinkers, which are almost like slag. The gases from the incinerator (where a temperature of 1500° to 1800° is maintained) are carried to the drier and do the drying. When starting operations, coal is used for an hour to dry the first sludge; after that, no additional fuel is needed. The stack is but 50 ft. high, but there has been very little odor; it is believed that with a 200-ft. stack there would be none.

Fresh-water mussels in contaminated water exert little if any, or at least no practical, bactericidal action.



Sludge digestion tanks at Essen-Nord.
Dimensions are in meters

There was no evidence of a general bactericidal effect or a selective bactericidal effect in experiments conducted at the University of Missouri School of Medicine in conjunction with the U. S. Bureau of Fisheries.[A4-12]

Concrete for sewer construction in Columbus, O., varied from 1 cement to 12 volumes aggregate for cradle and backing for clay segmental block, to 1:4 for high early strength concrete where backfilling in 4 days was desired.[K4-1] For general sewer construction, 1:5.5 or 1:6 was used. Wall forms for rectangular sewers were left in place 4 days; for roof slabs, 6 days for sewers and 7 days for regulator chambers; invert forms, 15 to 24 hours; arch forms, 2 to 3 days.

Storm water run-off in St. Louis was gauged at 0.6 the rainfall in a residential block of fairly good slopes[K4-1], slightly less than 0.4 for one of much flatter slopes, and slightly more than 0.8 for a semi-commercial block.

A sewer of cast iron pipe has been laid by the Long Branch Sewer Co.[Q4-1], using 30" pipes, lead joints, supported on timber bents, below high tide level, in sandy soil. Extra heavy pipe was used in crossing under a railroad.

Painting sewage plant structures is necessary, to prevent corrosion by acids, gases and moisture.[BB4-6] For protecting "concrete of Imhoff tank gas vents and other surfaces subjected to corrosive gases, where the tendency is for disintegration of the concrete to take place at the water line, a coal tar paint commercially known as Inertol has been used with a great deal of success," used at intervals of two or three years. The same material is useful for covering metals subject to alternate wetting and drying. Some asphaltic paints, especially Valdura, are useful for protecting steel and wood surfaces that are not subjected to too much moisture. Aluminum paints are superior to others for protecting frames and sash of sludge bed glass-overs, roof trusses of screen buildings and other surfaces subjected to a great deal of moisture and to sulphide gases.

But the best method of preventing corrosion about a sewage plant is using non-corrosive materials wherever economically possible—stainless steel, aluminums, bronze and some of the iron alloys. Also, better concrete and minimizing the surface area exposed to corrosion will tend to reduce the problem of maintenance.

Licensing operators of sewage and water treatment plants originated in New Jersey in 1918 and was adopted in Michigan in 1931.[BB4-8] New Jersey has issued licenses to 231 operators of water plants and 481 of sewage treatment works. Michigan has issued 58 licenses, all to operators holding positions at the time of the adoption of the regulations.

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c, Indicates construction article; *n*, note or short article; *t*, technical article.

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2. Water and Stream Pollution by Domestic and Trade Effluents, p. 212.
3. Population-Equivalent Conception of Sewage and Trade Waste Strength. By Dr. H. Rohde, p. 214.

February 16

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7. Simplex Sludge Digesters, p. 240.

March 2

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March 9

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14. Recent Developments in Domestic Drainage and Sanitation. By W. H. Scanlan, pp. 313-315.

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March 15

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March 22

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March

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5. N 3. Economy of Operating Low-Head Sewage Pumps with High-Speed Motors. By Charles Yeomans, p. 86.
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March

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March

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March

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Annual

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9. *t*. Procedure Recommended for the Biochemical Oxygen Demand Test. By Ohio Department of Health, pp. 61-63.
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11. List of Municipal Sewage Treatment Works in Ohio, pp. 65-67.

The Editor's Page

An Information Exchange at Your Service

Many requests for information come into this office. Most of them the editors are able to answer perhaps satisfactorily, yet it has seemed to them that some other method might be of greater value to the engineering profession.

Most of the questions are intensely practical, such as what kind of fence to put around a sewage treatment plant; how to make concrete pipe; how to build airport runways; how to build swimming pools, both earth and concrete; details of small reservoirs for villages of a few hundred population. On another page in this issue are printed some of the questions that have reached us during the past month—a few of them, only. We are throwing them open to discussion by our readers in the hope that by doing this a greater variety of information and newer data will be made available.

The ten or fifteen thousand city, county and state engineers in this country represent that many collecting points for information. A clearing house ought to be of value to everyone. We invite questions and answers, in the hope that these will result in a more rapid and complete interchange of new ideas, new methods and new knowledge.

Interest in Learning

The State of Massachusetts, through its Department of Education, presents an extension (correspondence) course in highway construction. It reports that the first two months of this year showed a 400% increase in enrollment over the same period last year. New jobs and the prospect of more, resulting from CWA and PWA road-building are considered the chief reasons for the increased enrollment.

More and more engineers (and others, too) are realizing that to progress, they must learn. There has been a very considerable change in the popular attitude toward correspondence instruction since the war. Shortly thereafter the Army began systematic instruction of reserve and regular officers and enlisted men, enrolling more than 100,000 students. These courses were hard, but interesting, as the writer found out in the course of accumulating some 2,000 hours of credit from them. Following this, many of the larger universities issued home study and extension courses and enrolled hundreds of thousands of students in them. However, we believe the International Correspondence Schools still remain by far the largest, so far as the number of students is concerned, and also has the greatest number of courses.

Home study offers tremendous opportunity for the man who lacked the opportunity for college training; and also for the man with college training, who needs specialized information or training. Licensing laws in many states have necessitated home study in order to pass license examinations. The shift and turmoil of the past three years have thrown many men into new and unfamiliar jobs. The more ambitious and energetic, determined to make good, have utilized home study to help master their work; and in many cases have fitted themselves for promotion.

We have often wondered at the lack of technical books in the average engineer's office. Are such books of no real value except to the undergraduate student? Can the engineer not afford to purchase those books that cover the subject or subjects which afford him a living? Certainly the sales of most engineering texts are not much encouragement to the would-be author. The general engineering handbooks have sold pretty well, and a few of the other texts; but the greatest field for sale appears to be to the college student. Do the books a man buys in college (which he is obliged to buy) carry him through all the rest of his professional life?

Perhaps the answer lies in the service rendered by the engineering magazines which present continually new data, new methods and new ideas, gathered from the best in the engineering field. In reading these magazines, the engineer unconsciously, perhaps, obtains a wider background of ideas and knowledge; and the ideas he gets concerning the work and ideas of others are undoubtedly stimulating.

Page Messrs. Metcalf & Eddy, Fuller & McClintock, Babbitt, and Others

"There has been no book on sewage disposal published since the world war." At least so states a gentleman in charge of sewage disposal for CCC camps for one of our most important corps areas, involving 50 or more camps.

If further enlightenment is needed, a couple more quotations will be of interest: "A dosage of 5 ppm. of chlorine applied at the inlet of the ordinary septic tank (10 x 12 x 6 feet deep) will sterilize and stabilize the effluent." For treating the septic tank effluent of two camps (400 men), he recommended a sand filter of "about 20 cubic yards."

These interesting bits of information, along with many others, were gleaned during a recent inspection of a number of camps, part of the trip in the company of the above-mentioned. Somehow or other, it appears to us the United States Government could find plenty of unemployed engineers familiar with sewage treatment to handle such work as this. Certainly it would save lots of money in the end, because everything installed which is based on such disregard of the principles of sewage treatment will be just about a total loss financially as well as fail to afford the protection against pollution of water and air which is aimed at and is highly desirable.

How does this strike our readers? And if they know of similar cases, what are they doing about it?

Ammonia-Chlorine in Filter Influents and Effluents

WHEN the water supply of Champaign-Urbana, Illinois, was first filtered, such luxuriant growths of iron bacteria developed as to prevent any flow through the sand, but pre-chlorination, begun in 1918, entirely remedied this, and has been continued to date with an average of 20 pounds of chlorine per million gallons. It has not, however, entirely eliminated the iron bacteria from the distribution system; and when, in 1931, the filters were out of service for a short time to be renovated, the iron growths in the distribution system increased many fold. To remedy this, ammonia-chlorine treatment in the filter effluent was tried.

The original dosage was 0.6 ppm of chloramine, 1 ammonia to 2 chlorine. After two weeks this dose was doubled; but as there was a decided taste, the dose was increased to 1½ parts of ammonia to 2 of chlorine. The trouble still persisted in the mains, and it was thought the filters might be saturated with the growths, and the influent was dosed with 0.9 ppm of chloramine. In 18 hours a slight residual showed in the effluents and in eleven days the residuals had increased to between 0.5 and 0.08. After four months the clear well was free from growths. As there were no phenols in the water, the ammonia in the influent seemed unnecessary and was discontinued. So much chlorine was consumed in the filters that it was necessary to apply additional chlorine to the effluent to furnish a residual for treatment of the distribution system. The filter effluent contained a small residual from the prechlorination, and it was feared that, if the usual procedure of applying ammonia first and then chlorine be followed, the former might combine completely with the residual, leaving none for the following dose of chlorine. Therefore the chlorine was applied to the effluent first and the ammonia afterward; and this procedure has been satisfactory to date in every detail.

The capacity of the iron bacteria to absorb chlorine is almost unbelievable. Month after month plant residuals of 1.0 to 0.7 ppm were reduced to zero before reaching the terminals of the distribution system, although the mains were meantime blown off frequently and great masses of growths so removed. After nearly two years of continuous chloramine treatment, a plant residual this year of 0.55 was reduced to from 0.05 to 0.15 in the distribution system.

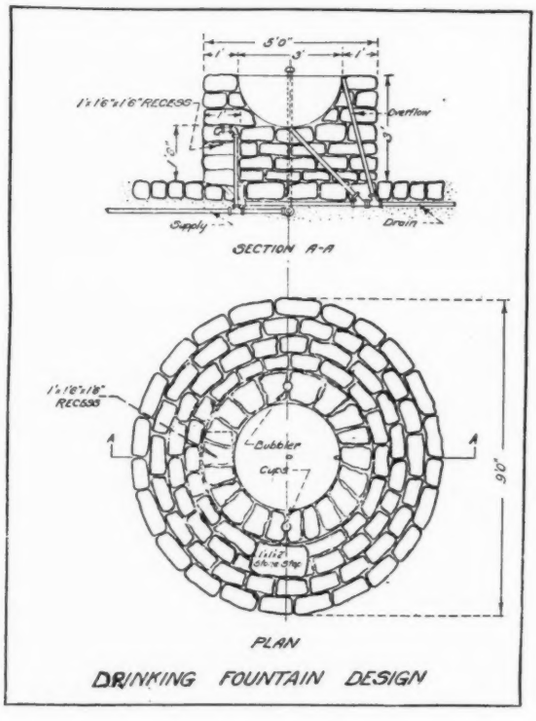
Danville, Ill., also found the filter absorbed most of the pre-chlorine dose. Raw water is pumped into a settling basin, and ammonia is introduced into the pump suction and chlorine into the discharge pipe ten feet beyond the pump. It leaves the settling basin for the filters between 10 and 11 hours later; and reaches the first consumer about 3 hours after leaving the filters. With residual of 0.4 ppm in the settling outlet there was none in the filter effluent. Then 12 lbs of chlorine per m. g. was charged into the filter influent, but the result was still unsatisfactory. The filter walls were then wire brushed and scrubbed down with H. T. H. and direct dosing of the beds continued, and in three weeks a residual of 0.2 in the effluent was obtained; and this year this residual is found uniformly throughout the distribution system. By the spring of 1933 the dose was reduced to 1.3 lbs. of ammonia and 5.4 lbs. of chlorine per mg, costing 62 cts; as compared to 87.5 cts, the cost when using 11.6 lbs. of chlorine alone which was necessary for maintaining the same residual.

Last fall algae conditions became bad, but were remedied by using 2.5 lbs. of ammonia and 16 lbs. of chlorine—10.6 in pre-chlorination and 5.4 in post chlorination. In the late spring of 1933 the dose was 1.1 lbs. of ammonia and 4.4 of chlorine. (The above information was furnished by Frank C. Amsburg, Jr., superintendent of the Champaign-Urbana plant, and Howard M. Ely, superintendent of filtration at Danville, in papers before the Illinois Section of the Am. Water Works Ass'n.).

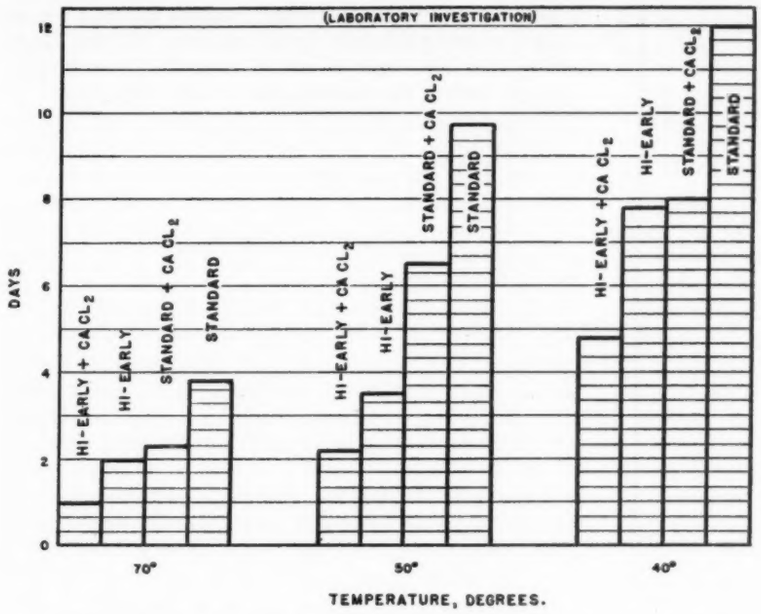
From investigations made at Bay City, Mich., Louis B. Harrison believes that residual chlorine should last for at least 2 to 2.5 hours to afford satisfactory sterilization; and that the *amount* of residual is immaterial so long as it does not disappear before the end of that period. Also that the water should not reach any consumer before the end of that period.

Drinking Fountain for Roadside Supplies

Where water is available along highways, particularly throughout the arid sections, the California Division of Highways constructs sanitary drinking fountains. The design, as shown herewith, is in accordance with the surrounding country, and local rocks, typical of the section, are used for construction. This is the "old well" type. The need for such facilities has been demonstrated by the large number of motorists which are found to use them.



DRINKING FOUNTAIN DESIGN



Effect of temperature on length of time required for pavement concrete to attain opening strength

Experiences in the Use of Early-Strength Concrete

By H. F. Clemmer

Engineer of Materials, District of Columbia

At a recent meeting of the American Road Builders' Association, this subject was discussed at length by Mr. Clemmer. The following is an abstract of his remarks:

A LABORATORY investigation by the highway department of the District of Columbia of the relative strengths of concretes maintained, while curing, at temperatures of 40°, 50° and 70° F., showed that at two days the compressive strength was 65% less for 50° concrete than for 70°, and 85% less for 40° than for 70°.

Tests were made also of the effect of rising and falling temperatures immediately after the placing of the concrete. In each test, the temperature was either raised or lowered for 12 hours, and during the succeeding 12 hours was returned to the original temperature. Concrete placed at 40° and rising to 60° attained greater early strength than that placed at 60° and falling to 40°.

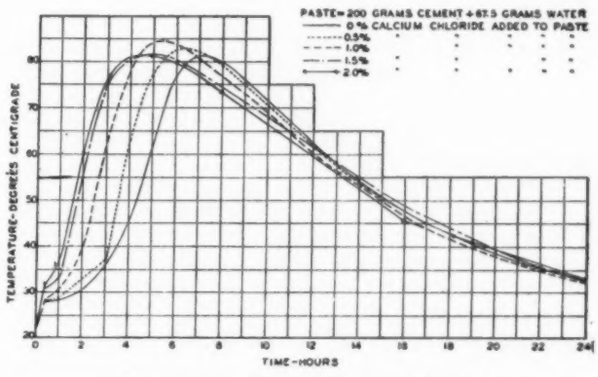
At any temperature (except below freezing) the strength of concrete increases with the age; and tests showed that the strength attained in three days by concrete maintained at 48° would be attained in one day by the same concrete if maintained at 70°.

Where traffic must be kept off a street while concrete sets and attains a specified strength, or in cold weather where the concrete must be protected or heated until well set, and under other conditions, it is very desirable to hasten the attainment of the necessary strength. Three methods of doing so have been tried by the District of Columbia—mixing calcium chloride in the concrete (1½ lbs. per sack of cement), using high early strength cement, and using more standard cement; also a combination of the first with each of the other two. The District specifications required that pavement concrete reach a strength of 300 lbs. per square inch in flexure before asphalt binder and top be placed on it. Tests showed that, when concrete is placed at 70°, pavements may be opened to traffic in one day when high early strength cement plus calcium chloride is used; in two days when either high early strength cement, or standard portland cement combined with calcium chloride, is used; and in four days when standard portland cement alone is used.

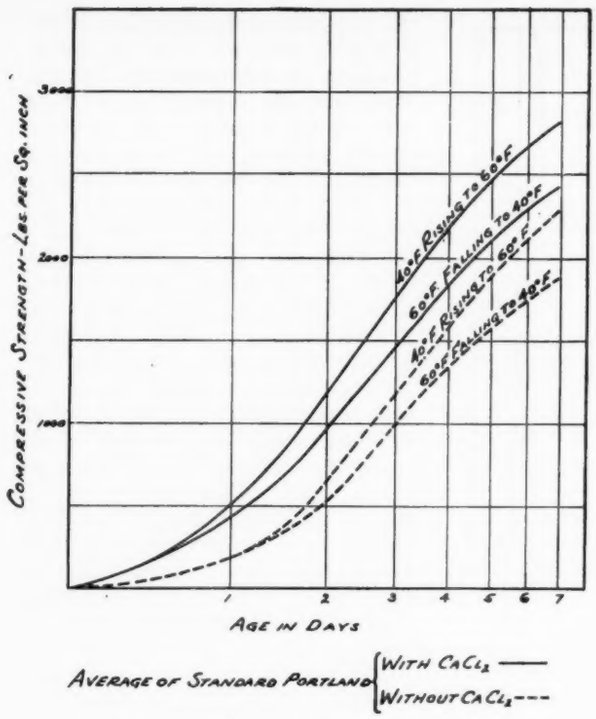
When concrete is placed at 50°, pavements may be opened in two days when high early strength cement plus calcium chloride is used; in three days when high early strength cement is used alone; in five days when standard portland cement and calcium chloride are used; and in approximately nine days when standard portland cement alone is used.

When concrete is placed at 40°, the times are four days for h.e.s. cement plus calcium chloride; seven days for h.e.s. cement, or standard portland and calcium chloride; and twelve days for standard portland cement alone.

The standard specifications of the District for base concrete called for 1.04 bbl. of cement per cubic yard (which has since been increased to 1.25 bbl.), which attained an average strength of 300 lbs. per sq. in. cured at 70° F. for 24 hours; while if 1.6 bbl. of cement be used, approximately 900 lbs. is attained. Use of calcium chloride increased these strengths to 500 lbs. and 1,300 lbs. respectively. Calcium chloride lowers the freezing



Temperature curves of cement paste



Effect of rising and falling temperature

point of water, but with the amount used in concrete this effect is insignificant; the real value of calcium chloride is its accelerating action. The above are laboratory results.

Field Practice

All concrete placed in the field since the above laboratory investigations have been controlled for temperature. In a paving job on F Street, one of the most important business streets, the required strength was obtained in from 24 to 30 hours under all temperatures. Tearing up the old pavement and preparing the subgrade was completed during the night so that concrete could be laid in the morning with a rising temperature. Laboratory investigations indicated that, within the temperature range encountered on this project, use of additional standard cement plus calcium chloride would give the desired results. Therefore, one extra bag of standard cement was used per cubic yard (increasing the amount by 25%), with more or less calcium chloride, depending on the temperature—generally 1 lb. per sack of cement at the higher temperatures and 1½ lbs. at the lower.

At one important alley entrance, concrete mixed with an extra bag of cement and calcium chloride was placed at 1 p. m., and specimens broken at 10 p. m. showed 280 lbs. strength, and planks were at once placed over the concrete and the alley opened to traffic. At 18 hours this concrete tested 415 lbs.

During low temperatures, concrete should be placed in the morning and permitted to have the afternoon, when the temperature is rising, to gain its initial set. As an illustration of the effect of rising and falling temperature, concrete was placed on Dec. 27th at 7 a. m. with temperature at 14° F. Six bags of cement were used per cubic yard of concrete, and 1½ lbs. of calcium chloride per bag. A test specimen taken at 10 a. m. broke 48 hours later at 415 lbs.; but one taken at 2 p. m. (when pouring stopped) reached only 286 lbs., indicating that too little time had elapsed for it to gain strength before the temperature started lowering.

In this F street work, on two blocks excavation started one morning, the concrete was laid and then the sheet asphalt, and the pavement opened to traffic on the second day following; five blocks were opened to traffic on the third day after excavation started; while the remaining three blocks were delayed by rain for from one to three days.

"The use of high early strength cement is of considerable value in overcoming the effect of low temperatures, due to its rapid rate of hydration, and its use in place of standard portland cement and calcium chloride or of additional standard portland cement and calcium chloride is a matter for economic consideration.

"The use of high early strength cement together with calcium chloride produces very marked results in the early strength of concrete, even when it is placed at very low temperatures and without special protection."

But when temperatures are near freezing, accelerated setting alone cannot be relied on, but canvas enclosures heated with salamanders, covering pavements with at least 6 inches of straw held in place with burlap, heating aggregates and mixing water and other precautions should be taken.

Following are the specifications for the cold weather protection of concrete as issued by the Highway Department of the District of Columbia:

"Whenever the temperature may reach fifty (50) degrees F., or lower, during the twenty-four (24) hours following the placing of the concrete, calcium chloride incorporated in the concrete mix shall be used for curing of the concrete, in lieu of whatever method of curing is being used. The cost of the calcium chloride, and its use, shall be included in the bid price per square yard of pavement.

"Whenever the temperature may reach thirty-two (32) degrees F., or lower, during the twenty-four (24) hours following the placing of the concrete, the surface of the pavement shall be covered with hay, straw, or other material approved and as directed by the engineer, for at least three (3) days.

"Heating of aggregates may be required during prolonged periods of freezing temperature, or lower.

"Preparation and use of calcium chloride shall be as follows: Place one bag (100) pounds of calcium chloride in a barrel and add sufficient water to make a solution of 25 gallons (one-half barrel). This solution should be stirred to be sure the calcium chloride is completely dissolved.

"An amount (1½ to 2 qts.) as directed by the engineer shall be added to the concrete mix for each bag of cement. The quantity of mixing water should be reduced by the amount of calcium chloride solution used. The method of incorporation into the concrete mix shall be approved by the engineer."

Painting Steel Bridges

Bridge painting in Georgia in 1931-32 (the period covered by the latest available annual report) was carried on by two crews. All painting was done by hand brushes. One crew cleaned the structures by hand, while the other cleaned with sand-blast equipment. The bridges were given either a full coat of red lead paint, or a touch-up coat of red lead, followed by a finish coat of aluminum.

For the bridges on which weights of structural steel were available (15 in all), the total cost of painting averaged $1.92 per ton per year, the costs varying from $1.20 to $3.41.

Echoes of The CWA

Sanitary Engineering in Wisconsin Aided by PWA and CWA

By L. F. WARRICK

Sanitary Engineer, Wisconsin State Board of Health

Abetted by the federal government, sanitation in Wisconsin in 1933 was headed for a degree of immediate development that would have taken from three to five years to achieve without the impetus provided by Washington.

Records of the bureau of sanitary engineering reveal that on December 1 a total of 54 sanitary projects, representing an estimated expenditure of more than $15,000,000, had been definitely entered under the PWA banner, and that, in addition to these, hundreds of lesser projects of the same general classification had been undertaken under CWA provisions.

Of the major projects, six are classed as waterworks and sewerage developments combined, 17 as waterworks developments, 29 as sewerage developments, and two as miscellaneous projects of a sanitary engineering nature.

Two of the sewerage projects, those of Milwaukee and Fort Atkinson, aggregating approximately $1,900,000 were under construction before the year ended, as was Eau Claire's $250,000 waterworks development, while bids had been taken for the Green Bay and Beaver Dam projects, which total about $900,000.

Fourteen other major projects, aggregating an expenditure of more than $6,000,000, have been approved by the federal government and will be undertaken as weather conditions and final local arrangements permit. The remainder of the projects were, on December 1, awaiting approval.

In addition to the long list of federal-state sanitary engineering projects, a number of such improvements have been launched independently by Wisconsin municipalities able to undertake them without government aid.

CWA Work in Charleston, S. C.

Considerable work of diversified character has been done under the CWA by Charleston, S. C. The city engineer, James H. Dingle, informs us that the projects so constructed include: A swimming pool for white people and one for negroes; brick building at the prison farm containing dormitories, dining room, kitchen, office, guards' quarters, etc.; 4 ft. by 5 ft. reinforced concrete drains on piles; excavation for yacht basin (between 85,000 and 90,000 cu. yd.) using hand shovels and wheelbarrows; garbage incinerator, 180 tons in 24 hr.; grading and ditching for extension of municipal airport; repairs and improvements at municipal abattoir; construction of agricultural exhibit building; improvement of parks and playgrounds and provision for public comfort; improvements at municipal golf course; repairs at Old Folks Home, S. C. Military Academy, College of Charleston, Charleston Museum, public schools, police station, fire stations, etc.

There were, naturally, very wide variations in the percentages of labor, material and equipment used in the different types of projects. Some work, such as that involving grading and "dressing up" unimproved streets was all labor with the exception of small tools and wheelbarrows. In the reinforced concrete drains, approximately 50% of the money went for labor, 45% for materials and 5% for construction equipment. In the yacht basin excavation, labor received about 90%, material 4½% and equipment 5½% (CWA work was discontinued before this job was completed). The incinerator, for which work has been nearly completed on the foundation only, will run approximately 43% for labor, 55% for material and 2% for equipment.

The Government allotment for material for all the municipal projects constructed under CWA did not exceed 10% of the total cost. Where material costs exceeded the limit for this set by the CWA the city contributed the balance.

Ohio Road Work Started Under CWA Program To Be Completed

It is expected that most of the major projects started under the CWA program in Ohio but unfinished April 1 will be carried on to completion under the new Federal Emergency Relief Administration "works division" program, which will operate under immediate supervision of the state relief commission.

Projects have been classified as follows:

Type	*% of Projects*	*% of Workers*
Streets and highways	40	47
Stream and ditch work	19	23
Waterworks and sewerage	4	7
Parks, playgrounds and cemeteries	12	11
Quarrying	3	1
Building construction and repairs	20	10
Airport work	2	1

Relief Workers on Highway Projects

"We found an entirely different spirit among emergency workers when they were working on projects of real value, such as widening of pavements or resurfacing old roads. Between Syracuse and Fayetteville, we widened a 30-ft. concrete road to 40 feet, and even though we had two or three new gangs each week, we found that our average speed was about two-thirds of that made by a contractor with a seasoned crew. It is difficult to make men apply themselves to jobs which they know would not be done in normal times, but when they are given real constructive work which is going to add to the safety and convenience of the general public, they are genuinely interested. They are not interested in raking leaves."

So states Arthur W. Brandt, commissioner of highways of the state of New York. He has hit the nail on the head, as he so often does.

The Water Wheel

Following are the essential features of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form and condensed and interpreted.

THE Ottumwa purification plant[A4-10] seems to "have everything"—primary aeration (aeromix) chemical storage, flocculator, primary settling basin, secondary settling, re-carbonation, re-carbonation settling, 8 m.g.d. filtration plant, final aeration, activated carbon treatment and final filtration, with a final treatment with ammonia and chlorine. The total cost of the 8 m.g.d. plant with chemical house, flocculator, settling basins and all equipment was $227,832.

The 20″ aeromix also acts as a quick mix for the lime, to maintain a pH of 10.7 at the end of the flocculator, tests being made here every 30 min. The shaft of the flocculator is set parallel to the direction of flow, giving a spiral motion to the flow through the tank. Sufficient soda ash is applied to reduce the non-carbonate hardness to a final 10 to 15 p.p.m., and enough sulphate of alumina to bring the pH to 9.8. The sludge from the primary basin is, and that from the secondary basin can be, discharged into the river. For re-carbonization, a centrifugal pump lifts the water into a 20″ aeromix through which the carbon dioxide gas is sucked into and thoroughly contacted with the water. A residual of about 0.88 to 1.0 p.p.m. of free CO_2 gas is maintained in the influent to the primary filters and a pH of 7.7. A feature of the filters is the bottom, consisting of a false bottom made of pre-cast concrete blocks with inverted V-shaped tops, spaced ½″ apart, supported 18″ above the real bottom. Wash water is supplied to and effluent removed from the space under the false bottom through three 8″ c.i. pipes drilled with two rows of 1″ holes 8″ apart located in the bottom third of the pipe. The filtered water receives 25 to 30 lb. per m.g. of activated carbon and is then filtered again through the old rapid filters.

Activated carbon is used in Richmond, Va.,[A4-9] when objectionable tastes and odors are present. "We have found that, within limits, when water is filtered through carbon rather than the carbon mixed in the water, only about one-tenth as much is required for the same taste/odor removal. . . . The carbon feed should be so arranged that controlled quantities may be applied either directly onto the filters or before or with the coagulant, or both; . . . an accurate study of conditions at each plant and under different water conditions must be made to determine the most economical quantities and place of application.

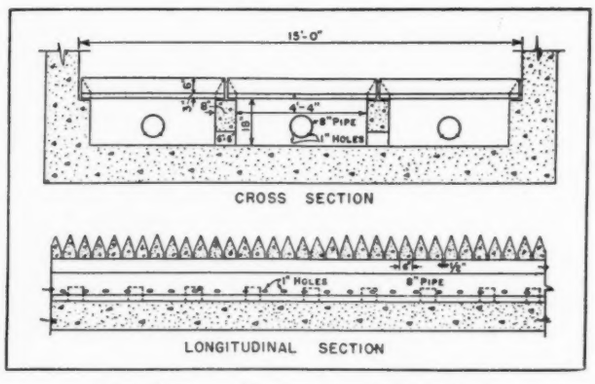
A very **active carbon** is more than 100 times as effective as ordinary charcoal, and there is a great difference in absorptive capacity of various carbons.[L4-4]

Copper Sulphate is used in the settling basins of the Richmond, Va., plant[A4-9] for the control of organic growths. "During the past several years a marked improvement in the control of growths has been obtained with even less use of this chemical by continuing the treatment during winter months rather than waiting for growths to appear, as was the former practice."

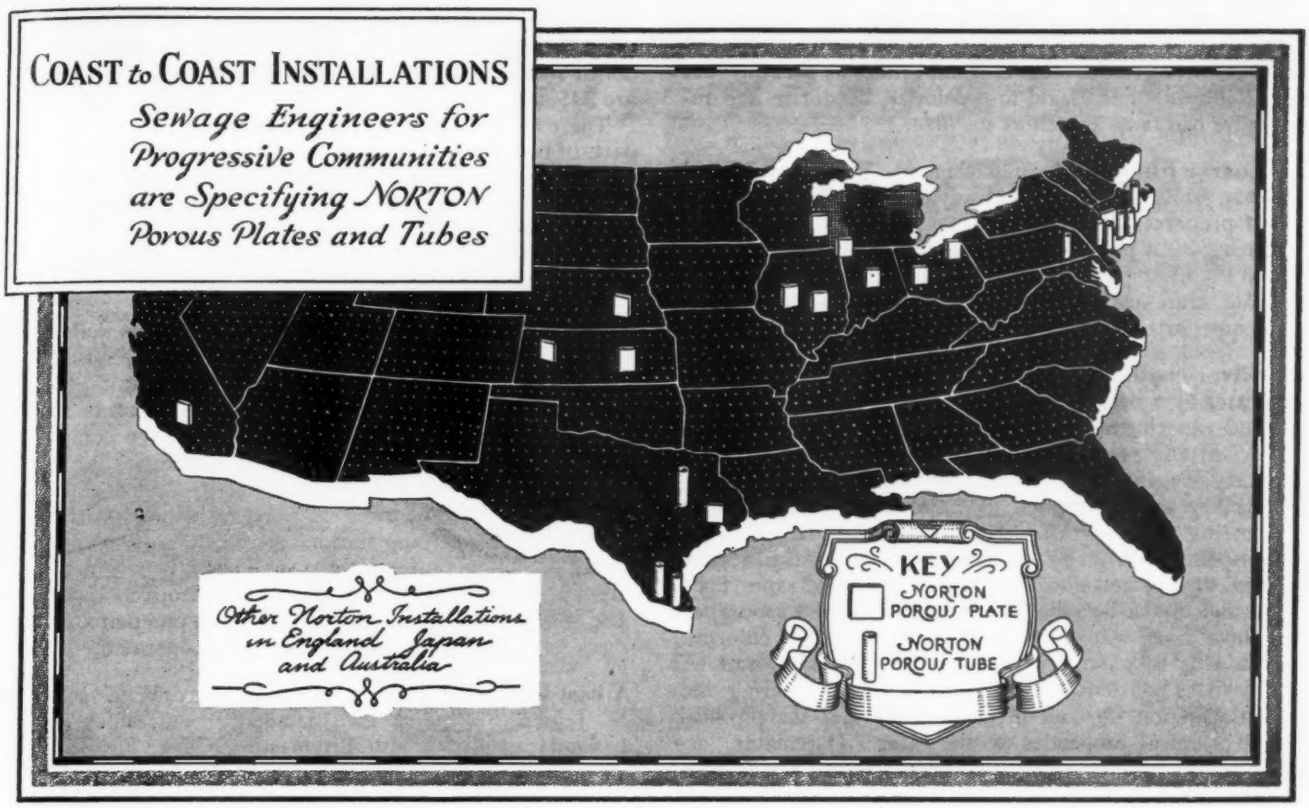
Chlorine (as H.T.H. or other non-deteriorating compound), copper sulphate and activated carbon should be kept on hand in safe storage for emergency use by every water works, said Arthur E. Gorman.[A4-7] "The drought of 1930-31, with low water stages, continuous sunshine and increased water temperatures caused prolific algae growths in reservoirs, with resulting tastes and odors in the water. Water quality was compromised by the use of supplemental sources of supply exposed to serious pollution. These experiences in thousands of water works throughout the United States should have taught every water works official the need and wisdom of owning an emergency chlorinator" and keeping the above-named chemicals ready for emergency use.

Soda ash and other chemicals were first handled by the pneumatic suction system in a municipal filtration plant in 1925. This system has recently been installed in the Columbus, O., plant,[G4-2] consisting of intake pipeline, including flexible hose and an intake nozzle, receiving station, filters to clean the conveying air, and a vacuum pump. To unload a car of soda ash, the vacuum pump and the motor to drive the discharge mechanism under the receiving station are started. Atmospheric air is drawn in at the intake nozzle and, when nozzle is immersed in the ash, the inflowing air carries it in a steady stream at high velocity to the receiving station, where abrupt decrease in velocity causes precipitation of ash in the hopper, while the conveying air is drawn through filter cloths. The soda ash may be taken by screw conveyors to either of three bins, each holding 5 tons. The remainder of the car-load is bagged and stored for use. The pneumatic system delivers regularly 7 to 8 tons of soda ash per hour. There is no dust nuisance anywhere. Only one man (at the nozzle) is required. The present soda ash consumption is 3,000 tons, and there is a saving in cost of soda ash of $2.50 per ton by buying it in bulk instead of in bags. The pneumatic, weighing and chemical feeder equipment cost $10,000 and will be paid for from savings in 15 months.

Ozone treatment of water was tested in London, as a result of which "the Metropolitan Water Board of that city, on the advice of the late Sir Alexander Houston, have decided to install a plant of 15 mgd capacity at Hornsey [F4-11]. Paris at the present time is putting in



Filter bottom, Ottumwa purification plant



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Pages 53, 60 and 61 contain descriptions of many helpful booklets—Don't forget to look them over.

a 66 mgd plant, in addition to the existing plant, while several cities of smaller size are also installing plants." The cost of this process is several times as great as that of chlorine, but it said to decolorize, deodorize and remove bad taste as well as sterilize.

Coarse filter sand in Richmond, Va.,[A4-9] indicated that, while it has material advantages, the importance of preparation of the water for filtration is vastly increased. "A poorly prepared water throws such a burden on the filters that, for a successful effluent, the filtering rate, sand size and filter operation must be adjusted to compensate for this deficiency in preparation."

Silver-coated sand has been tested for sterilizing water by a number of German and other investigators, and experiments in Russia have been made by Union Scientific Research Institute of Water Supply and Sanitary Engineering.[A4-6] In these tests, the most satisfactory sand contained 0.3% of katadyn silver as a coating on the grains. The water is first freed of all suspended matter by sedimentation and sand filtration, and then passed slowly through the silvered sand. They found the bactericidal effect of this silvered sand upon Neva river water was greater than that of chlorine, showing no colonies in 1 cc on Agar 10 days out of 13. It "does not denature the natural water as boiling and chlorination do, and in no way changes the physical or chemical properties of the water." It remains "active," destroying bacilli that may enter the water after treatment. After 5½ months of use the sand had lost none of its original oligodynamic power, but in time gradually disappears. The cost is given as 3,000 marks for 1 c.m. of katadyn silver.

Taste in water of Grand Forks, N. D.,[A4-4] when river was very low was transmitted to cooked food, raw water was decidedly black with an intense sewage odor, being loaded with all types of domestic wastes and gas plant products. Dosage of powdered charcoal increased to 200 lb. per m.g. in addition to upward flow through charcoal bed and increasing ammonia dosage to equal chlorine dose made water fairly palatable. Then ice formed in river, BOD increased and hydrogen sulphide formed; chlorine was increased from 11 lb. to 60 lb. a day but no residual could be obtained; chemicals cost $77 per m.g. Later, in January, hydrogen sulphide increased, and chlorine dose increased to 160 lb. per m.g., applied to raw water, before and after sand filtration, and ammonia to 50 lb., applied directly before first chlorination; and the charcoal dose rose to a maximum of 715 lb. per m.g. The tap water was kept safe and of fairly good taste. As conditions in the river became worse they discovered that, when the bacterial count at the bottom of the intake pool was 10,000 per cc., that at the top was only 300, and although the bottom water had a color like blue ink, that at the top was fairly clear. Water was then taken from near the surface instead of the bottom, and at once the chlorine dose was dropped from 150 lb. per m.g. to 25 lb., charcoal from 700 to 350 lb., ammonia from 35 to 25 lb., and the cost for chemicals dropped from $140 per m.g. to about half that, and a better and tastier product obtained.

Electrification of the pumping plant of Pittsburgh's Brilliant pumping station [A4-3] was estimated to cost $900,000 and a new steam plant $1,730,000; but the total annual cost (including fixed charges) of the former was estimated to exceed those of the latter by $36,000. But financial conditions caused the choice of the former. However, the efficiencies of the electric plant were better than expected and the annual operating cost is $221,000 as against $287,000 for the abandoned steam plant, and the fixed charges of the former are $45,400.

There are six pumping units of two capacities and all parts of both sizes, except the impellers, are interchangeable. Each pump has a 24-inch automatic cone valve, hydraulically operated and controlled by differential pressure; which type of check valve has entirely eliminated the danger of excessive surges in the rising mains when the pumps are stopped.

Booster stations are used by Grand Rapids water system to maintain pressure in outlying residential districts during peak loads, which are about four times the normal winter demand. "Some of the districts so helped are as much as five and six miles from the pumping station, and the cost of installing additional large trunk mains at this time was prohibitive." There are four booster stations, three operated by remote control from the main pumping station; the fourth contains two 1 m.g.d. pumps, one starting automatically when the pressure drops to 80 lb., the second if it drops to 75 lb. The others are 5 m.g.d. and 10 m.g.d. All pump around check valves in the mains, and are motor operated.

A cast-iron pipe line is being laid by Wildwood, N. J., 12", 14" and 16" diameter[Q4-2], of super de Lavaud pipe lined with Bitumastic enamel. For fear hot lead joints would damage this lining, Anthony mechanical joints were used throughout.

Moving a cast-iron pipe line under pressure was performed under unusual circumstances by the Marin, Calif., Municipal Water District[Q4-3]. The line, laid in 1910, was under 140 lb. pressure, and 1600 feet of it was in soft ground. A highway fill paralleling it caused the marshy ground beyond the fill to rise and to move horizontally 10 to 12 ft. To prevent the pipe line being moved this distance (which varied considerably from point to point), it was dug up and placed on skids on the ground surface and moved toward the fill as the ground moved outward, so as to keep it in alignment; being continuously under pressure. Some spigot ends pulled out of the bells as much as ¾", and angles of up to 4° in line at a single joint occurred, but after the line was straightened and joints recaulked there was no leakage.

A soil corrosion and pipe coating investigation has been under way for ten years at the Bureau of Standards under the direction of K. H. Logan.[A4-2] Results and conclusions up to July, 1933, are summarized in this paper. They deal with ferrous pipe with and without metallic protective coatings; brass and bronze service pipe and fittings, both alone and in contact with other metals; also with protective coatings for pipes. Scores of samples were buried in 47 different locations scattered over the United States, and a few have been removed and examined at intervals of about two years. It is planned to remove practically all the remaining specimens this year, and it is expected to take about three years to prepare the final report.

Steel plate pipe fabricated with automatic fusion welding give a smooth inner surface [L4-4]. The field joints are made either by fusion welding or by couplings of the Dresser type, or both. Steel pipe made with plates wound spirally and with joints both interlocked and electrically welded is on the market and test well for bursting strength.

Transite pipe, made of asbestos fiber and portland cement consolidated under pressure, used extensively in Italy, has been introduced here where resistance to tuberculation by water, to soil corrosion, and to electrolysis is desired.[L4-4]

Water tank risers are heated by electricity at a Naval station in New England[E4-1], by winding spirally around each of two risers two 2-conductor copper cables No. 14 A.G.G., varnished-cloth-insulated and lead sheathed, the two conductors of each cable being spliced at one end, making each heating element in effect 2500 ft. of No. 14 copper conductor. One riser is 10-in. flanged c.i. pipe 86 ft. long, the other 8-in. flanged c.i. 45 ft. long. The cables were wound spirally around the riser and covered with tightly wrapped asphalt-saturated asbestos paper bound in place by wire bands; and this was covered with two layers of 1½-in. hair felt, this in turn with building paper, and, outside of all, a 20-gauge galvanized sheet metal casing. With 115 volts applied, each conductor may consume 7,035 b.t.u. per hour, and the loss at 50° temperature difference would be 2,550 b.t.u. per hour.

Lowering a water tank of 50,000 gal. capacity on a 60-ft. steel tower 20 ft. was accomplished by means of oxy-acetylene cutting blowpipes.[U4-1] Tank and tower were securely guyed, and the four legs shortened 4 in. one at a time, and this repeated sixty times, and the new ends of the legs welded to the old bed plates, which were anchored to the foundation by new anchor bolts.

Rewashering taps by water departments and companies without charge to the consumer is recommended [D4-1], as "the small expense involved will be amply compensated by the savings in water."

Rolled earth dams are being compacted with the the sheep's foot roller and solid-tired trucks in increasing numbers, particularly in the West.[L4-4]

"Fresh-water mussels in contaminated water exert little, if any, or at least no practical bactericidal action.[A4-12] There was no evidence of a general bactericidal effect or of a selective bactericidal effect. These experiments apparently show that fresh-water mussels are not of any great value in the destruction of bacteria in general, nor are they important in the destruction of the most important group of bacteria with which streams may be contaminated, — the colon-typhoid group."

Biography of Recent Water Works Literature

c, Indicates construction article; *n*, note or short article; *t*, technical article.

A—*Journal, American Water Works Association*

February

1. Stream Flow Study of the Tokyo Water Supply. By Tomihisi Iwasaki, pp. 163-175.
2. Soil Corrosion and Pipe Coating Investigation, Bureau of Standards. By Leonard P. Wood, pp. 176-188.
3. Electrification of the Brilliant Pumping Station at Pittsburgh, Pa. By James H. Kennon, pp. 189-193.
4. Treating Dwindling Water Supplies in Northwestern Minnesota. By E. L. Lium, pp. 194-200.
5. Investigation of Ground Water in the Elizabeth City Area, North Carolina. By S. W. Lohman, pp. 201-216.
6. Sterilization of Drinking Water by Silver Coated Sand. By S. V. Moiseev, p. 217-238.
7. Meeting Emergencies in Water Works. By Arthur E. Gorman, pp. 239-246.
8. Grand Rapids Water System. By Carl H. Grinnell, pp. 247-252.
9. Richmond, Va., Filter Plant. By Marsden C. Smith, pp. 253-259.
10. New Water Purification Plant at Ottumwa, Ia. By Horace A. Brown, pp. 260-270.
11. Improved Method for Measuring Porosity of Sand. By Roberts Hulbert and Douglas Feben, pp. 271-274.
12. Fresh-Water Mussels and the Bacterial Content of Water. By M. P. Moon and Mary Alice Hamilton, pp. 275-282.

D 4 — *The Surveyor*
March 2
1. Water Shortage: Provision of Supplementary Supplies, pp. 283-284.

E 4 — *Engineering News-Record*
March 1
1. Heating Water Tank Risers by Electricity. By J. N. Laycock, p. 292.

March 8
2. Removal of Copper Sulphate from Water by Alum Coagulation. By C. J. Brockman, pp. 326-327.

March 15
3. Soil-Bearing Test for Columbus Water Tanks. By F. S. Besson, pp. 345-346.

F 4 — *Water Works Engineering*
March 7
1. Treating a Badly Polluted Supply. By Horace A. Brown, pp. 204-206.
2. Resistance of Service Pipes to Corrosion. By F. W. Gilcreas, pp. 210, 230, 233.
3. *c.* Laying Intake Line to Deep Water. By W. S. Williams, pp. 211-212.
4. Plant Efficiency Improved by Training Operators. By E. S. Tisdale, pp. 226, 229.

March 21
5. Beautification with a Lean Budget. By V. J. Hultquist, pp. 258-260.
6. Waste Survey Produces Big Saving. By A. A. Ross, pp. 261-263.
7. Reasonable Water Loss in Plant and System. By Neal W. Knight, p. 263.
8. Easton Filter Plant Ends Taste Troubles, pp. 264-266.
9. Good Will Promotion Profitable. By L. S. Vance, p. 266.
10. Continuous Pressure Recorders in Distribution Systems. By T. L. Amiss, p. 283.
11. Four States Section Discusses Ozonation, pp. 267-270.

G 4 — *Water Works and Sewerage*
March
1. Experiences with Chlorinated Copper as a Coagulant. By L. C. Billings, pp. 73-77.
2. A Self-Liquidating Water Plant Improvement. (Handling soda ash.) By Charles P. Hoover, pp. 84-86.
3. New Water Purification Plant at Ottumwa, Ia. By Horace A. Brown, pp. 92-95.
4. Sealing Abandoned Coal Mines. By B. F. Hatch, pp. 99-100.
5. *n.* Water Authority for North Jersey Supplies Proposed, p. 100.
6. The Atlanta Water Sampler. By Paul Weir and J. W. Allen, pp. 101-102.
7. Valve and Hydrant Inspection in North Andover, Mass. By W. B. Duffy, p. 103.

H 4 — *Municipal Sanitation*
March
1. Water Purification from the Standpoint of the Sanitary Engineer. By Edw. S. Hopkins, pp. 85-90.
2. Amebiasis Outbreak Due to Defective Plumbing in Chicago, pp. 98-99.

I 4 — *Pipe Progress*
March
1. Insurance Savings Will Retire Bonds, pp. 14-15.

J 4 — *American City*
March
1. Per Capita Consumption—Is It a Reliable Measuring Stick? By H. P. Bohmann, p. 61.
2. Dome Roof on Elevated Steel Water Tank. By A. L. Schmidt, p. 65.

K 4 — *Proceedings, American Society of Civil Engineers*
March
1. *t.* Evaporation from Water Surfaces: A Symposium. By Carl Rohwer, Robert Follansbee and Sub-committee, pp. 369-380.
2. *t.* Stability of Straight Concrete Gravity Dams: Discussion. By F. Knapp and S. H. Woodward, pp. 384-392.
3. *t.* Formation of Floc by Ferric Coagulants. Discussion. By E. S. Hopkins, W. D. Hatfield, L. B. Miller and L. H. Enslow, pp. 419-424.

L 4 — *Civil Engineering*
March
1. Underground Corrosion of Ferrous Pipe. By K. H. Logan, p. 128.
2. Flow of Water through Sand. By Gordon M. Fair. p. 137.
3. Filter Materials for Water and Sewage Works. Committee Report. p. 158.
4. World Progress in Water Supply Engineering.

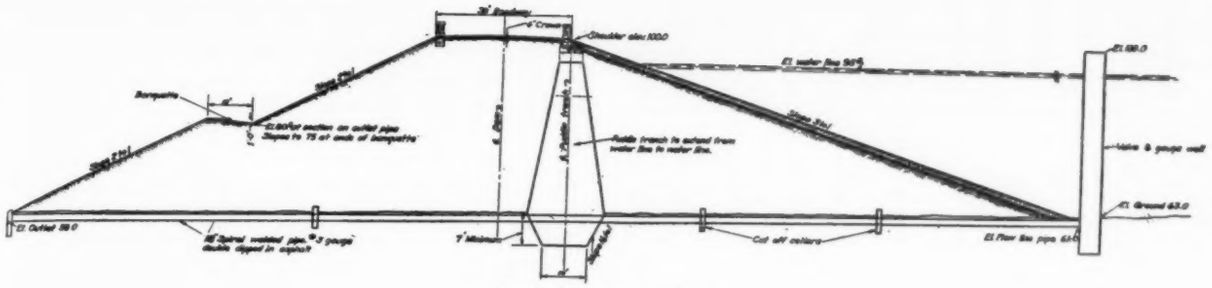
M 4 — *Canadian Engineer*
March 6
1. Enameled Parts for Well Pumps. By S. N. Flohr, p. 15.

P 4 — *Public Works*
March
1. Welding Steel Pipe Reduces Friction, p. 8.
2. Estimating Run-off Capacities of Water Sheds, p. 13.
3. Water Chlorination Economies in Chicago, p. 39.
4. Water Consumption Data in New Bedford, p. 47.

Q 4 — *The U. S. Piper*
March
1. Norwalk, Conn., Installs New 20-inch Pipe in 18-foot Lengths, pp. 1-3, 16-17.
2. Wildwood, N. J., Lays de Lavaud Pipe, Bitumastic Lined, with Anthony Joints, pp. 6-7, 17.
3. Marine Municipal Water District Lifts Pipe Out of Shifting Trench, pp. 8-9, 14.

S 4 — *Construction Methods*
March
1. Big Pipe Line Arc-Welded on Steep Slopes, pp. 26-28.
2. Cableways Place Concrete in Boulder Dam, pp. 38-39, 42-43.
3. Labor on PWA and CWA Projects, pp. 29-31.

T 4 — *La Technique Sanitaire*
December
1. Amelioration de la Distribution d'Eau de Toulouse. By D. Herisson, pp. 390-397.



Typical section of dam

Earth Fill Dam Built by the CCC in Kansas

By Murray A. Wilson
The Wilson Engineering Co., Salina, Kans.

THE Kansas Forestry, Fish and Game Commission has, during the past eight years, been developing a system of state parks as game preserves and by the close of the year 1932 had acquired title to nine parks. Water areas in these are being stocked with fish, and in six of the parks the commission had constructed dams costing from $10,000 to $120,000 each, creating lakes of 95 to 650 acres to be used for this purpose. As the aims of the commission became better understood, offers of land for additional parks were made, but its funds (which are derived from the sale of hunting, fishing and trapping licenses) were so depleted that normal operation required all of them and none were available for developing new lands.

Last year it became possible to obtain the services of eleven companies of the Civilian Conservation Corps to aid in the work of the Forestry, Fish and Game Commission, five of which are at work building dams, three on reforestation, two on soil erosion control, and one improving a memorial park. One of the first tracts of land offered for a park after these men became available is in Finney County on a small tributary of the Pawnee river. Here a dam is being built, a fence will be built surrounding the land, and trees will be planted wherever the soil is suitable. Two companies of CCC men are engaged on this dam.

The area draining to this dam covers approximately 21 square miles, practically all of which is native buffalo grass pasture land. It is roughly oblong in shape and a little more than twice as long as it is wide. The slope of the valley varies from one-half to one per cent near the lake site, rising to three per cent in the upper portions of the area. The slopes of the adjoining hills vary from two per cent to ten per cent. The soil shows much greater variation than is usual in most parts of western Kansas. Within the area, soils include loam, clay, shale, gypsum, magnesia limestone and calcite. The limestone and calcite occur in isolated ledges 50 to 60 feet above the floor of the valley. The shale, prominent on one side of the valley only, is soft, black and slow to support vegetation even though it appears to have disintegrated completely. There are sand pockets occurring in the hills but none of any large extent; the sand is of fair quality, composed mostly of coarse fragments. The valley floor is composed largely of a fine grained loess. At a depth of 6 to 10 feet a layer of water-bearing sand is encountered, which varies in thickness one to ten feet. It is confined entirely to the valley proper, and extends for a length of 600 feet.

There are almost no authentic data available on which to base estimates of flood flows and runoff. It is a region of scanty rainfall with an average annual precipitation of about 19 inches. It is also a region of violent storms which occur at rather rare intervals. One storm has been recorded within recent years within two miles of the site where 11 inches of rain fell in ten hours. The only data on runoff in this region have been obtained from much larger areas and are probably not directly comparable. It is realized that there will be a wide variation of water level in the lake and in order that this variation may be utilized in the future it is planned to install a recording water level gage in order to keep accurate check on the inflow and outflow of water through the lake. This work will be carried on in cooperation with the Division of Water Resources, Kansas State Board of Agriculture, of which George S. Knapp is chief engineer. The valve well has been designed to accommodate one of the standard recording gauges of the water resources division of the U. S. Geological Survey. In order to obtain accurate information from these level gauge records, the topography of the lake site was taken with unusual care, this being done with a plane table and contours drawn at differences of elevation of two feet.

The dam will be an earth-fill structure with a semi-hydraulic filled core. The top width was made 40 feet in order to provide room for a roadway. The up-stream slope will be 3 horizontal to 1 vertical, the down-stream slope 2 horizontal to 1 vertical with a banquette designed to check erosion on that side of the dam during times of heavy rainfall.

The original borings did not disclose the extent of the underlying gravel, and as the puddle trench was excavated, this sand and gravel stratum was found to be deeper and longer than was indicated on the plans. The trench is being carried down a minimum of 2 feet into the dense clay underlying the sand stratum. The up-stream slope will be riprapped from top to bottom with one-man stone 12 inches deep, placed on a sand-gravel bed. The rock to be used for this purpose is available in an outcrop adjacent to the park and the quarrying of it is well under way. At the top of the riprapped slope will be a parapet wall, also made of native stone. At the opposite shoulder of the roadway, a guard fence with posts to match the parapet wall will be constructed. The roadway will be crowned longi-

tudinally as well as transversely, the longitudinal crown being introduced to take care of any settlement.

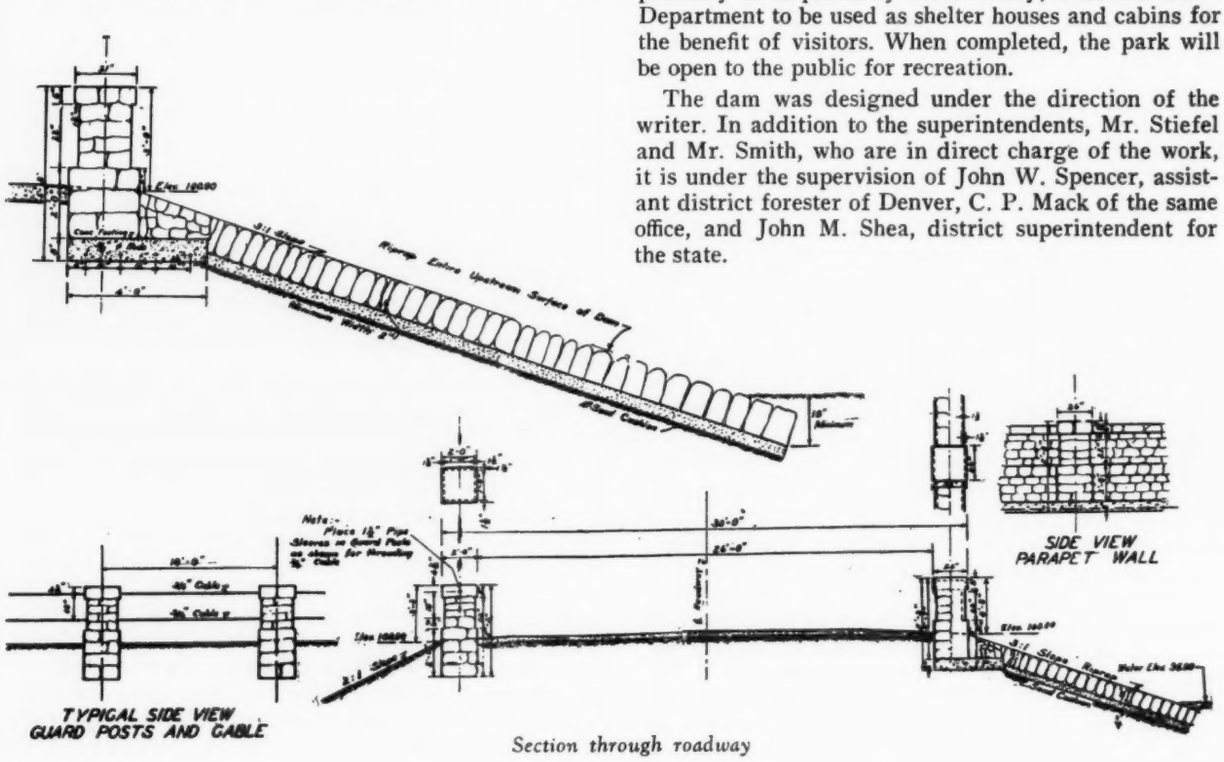
The design of the spillway presented a problem due to the fact that there is real probability of its never being used. On the other hand, should one of the violent storms occur with the lake almost full, adequate spillway capacity is essential. To meet these conditions, an open ditch spillway was designed. It will be 500 feet wide and finished to an elevation of 5 feet below the lowest portions of the dam. Where the cut emerges into the hillside below the dam, the ground will be riprapped for the full length of the spillway and down to a natural break in the grade with a marked reduction in slope. This was decided on after due consideration of the possibilities of heavy runoff and of the fact that even at times of heavy runoff, the time of overflow will always be short.

Two companies of Civilian Conservation Corps men were moved to the site in the latter part of October. The camp had previously been built by civilian employees under the direction of U. S. Army officers from Fort Riley. It was originally proposed to construct sod houses similar to those used by the early settlers of the region. It was found, however, that, due to the extremely dry season, the sod was in such a condition that it could not be used; so the plans were changed to construct the houses of adobe brick after the pattern of such construction used in the more southwesterly states. This was an unusual departure for this part of the country but has proved successful. Outside of the loss of a few bricks due to freezing, the construction was completed without difficulty. Enough barracks were built of the adobe brick to house one company of 200 men completely. The barracks of the other company were constructed of lumber, because the weather made it impossible to properly cure the sun-dried brick. After the few days necessary to get established in the camp, the men were put to work clearing the sod from the dam site. The excavation for the puddle trench has been done entirely by hand. It is almost complete and part of the puddled backfill is in place. The work is in charge of A. C. Stiefel as senior camp superintendent. The U. S. Army officers from Fort Riley are in charge of the camp and are responsible for the men while in the camp. The superintendents have complete charge of the work. The men work 40 hours per week.

The Forest Service is now providing the men with adequate machinery to push the work at a rapid rate. The Kansas Forestry, Fish and Game Commission furnishes the materials of construction that are necessary. The camp is now provided with a fleet of 12 trucks, 30 dump wagons, 90 head of mules, a bulldozer, a blade grader, a rooter plow, and a sheeps-foot roller. The fill is well started and in order to use the machinery and equipment to the best advantage the men are worked in two shifts. Their schedules have been staggered so that the men of one company are used entirely on one shift, and the men of the other company comprise the other shift. The superintendents, assisted by their foremen (some of the latter being also engineers), keep close check on the quality of the soil going into the fill. A check is made on the size of the material by the hydrometer method. Record is kept of the specific gravity, the amount of moisture, shrinkage factor and water-resistant qualities as shown by the standpipe permeameter. The quantities involved in the construction are approximately 200,000 cubic yards of earth fill and 9,000 cubic yards of rock.

A planting plan for the park has been worked out by the state forester and, while a small amount of planting is to be done this spring, that phase of development will be completed next year. The park will be fenced with barbed-wire fence, using stone posts from the local quarry. After the companies have completed their work and abandoned the camp, the buildings will probably be acquired by the Forestry, Fish and Game Department to be used as shelter houses and cabins for the benefit of visitors. When completed, the park will be open to the public for recreation.

The dam was designed under the direction of the writer. In addition to the superintendents, Mr. Stiefel and Mr. Smith, who are in direct charge of the work, it is under the supervision of John W. Spencer, assistant district forester of Denver, C. P. Mack of the same office, and John M. Shea, district superintendent for the state.



Section through roadway

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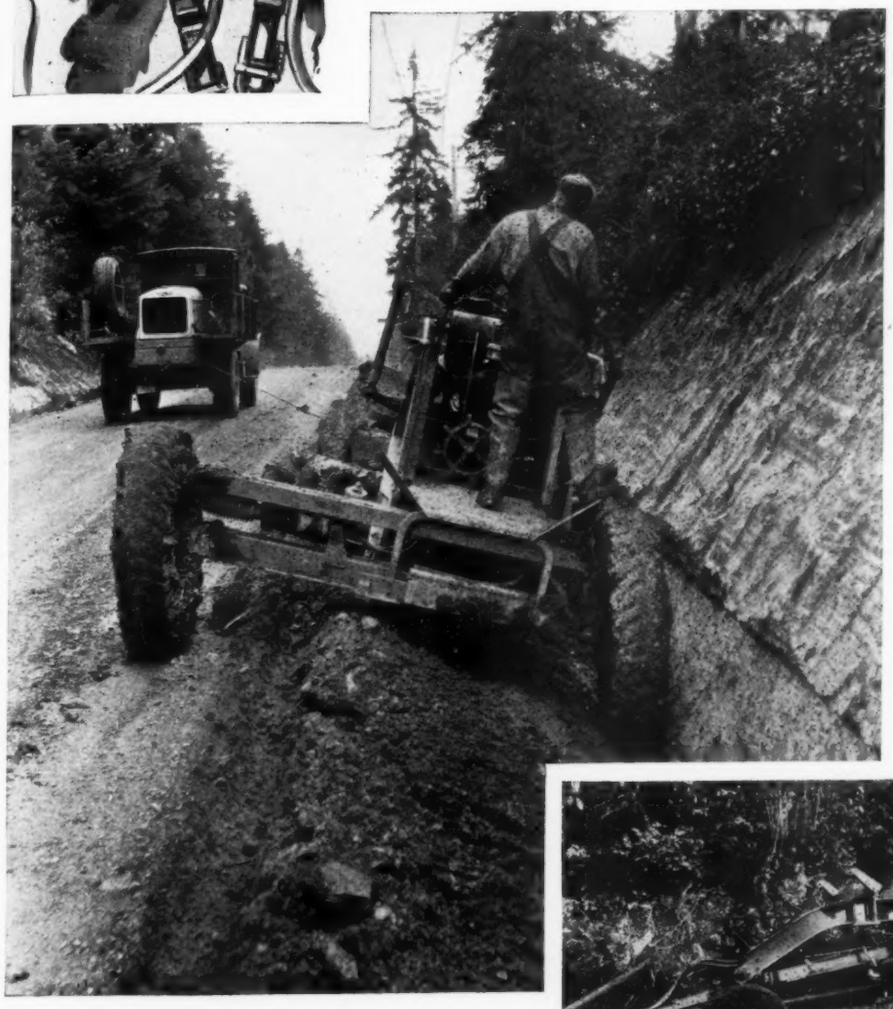

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Roadside Improvement Furnishes Immediate

By Wilbur H. Simonson
Landscape Architect, Bureau of Public Roads

(Continued from the March issue)

THIS is the second of a series of three articles which Mr. Simonson has prepared from data presented by him to the American Society of Landscape Architects. The third will appear in the May issue.

Competent Organized Supervision Needed

The most satisfactory roadside improvement can be obtained only under the direction of men trained in landscape and horticultural work. Highway engineers can no doubt apply many of the principles which have been developed, such as those affecting grading operations, but they have neither the time nor the training required for landscape work. Where adequate organization is not available for immediate work, a landscape architectural consultant might well be employed to prepare general instructions for the landscaping field forces until a proper and adequate organization could be effected. The important problems of design, administration, and maintenance should be unified for best results. The satisfactory foundation of any constructive program, however large or small, is a right start in accordance with a carefully studied plan.

Conservation of Natural Assets a Primary Objective

Roadside work embraces the conservation and care of all existing trees (pruning, spraying, feeding or fertilizing, etc.); the selective cutting or thinning of existing growth, the removal of stumps, dead material, loose stones, and/or other debris which will interfere with maintenance operations; the obliteration of borrow pits, traces of old roads, and/or other construction scars; the widening of shoulders and the elimination of hazardous side-ditches, the flattening of slopes, and the rounding of slope intersections; the smoothing out of rough places on the right of way that would interfere with mowing or other maintenance operations; the topsoiling, soil improvement, and seeding or sodding of shoulders and slopes; the advance preparation of planting areas, and the appropriate planting of raw slopes, incidental structures (bridges and culverts), and intersections, with a sufficient amount of suitable trees and ground cover materials to accomplish a reasonably comprehensive roadside improvement. Special constructions of scenic overlooks; picnic areas with fireplaces, tables, rustic seats and benches, etc.; wayside parks, and footpaths or walks, should be considered as a practical means of serving the public need for the parking of motor vehicles at a safe distance from the travelled way.

Natural Plantings More Suitable Along Rural Highways

The planting of trees at regular intervals without regard to their environment is not satisfactory roadside improvement work. Properly qualified landscape architects and horticulturists should be employed to determine the most effective arrangement of the roadside plantings and to select the proper kinds of plant material to be used in different soil and climatic conditions for each particular project location. The dominant factor is the general composition or grouping of the trees and ground cover materials in locations designed to fit the particular conditions. The selection of appropriate types of material is more important than the variety used—as large street shade tree types, flowering small bushy tree types, native shrubs of free and graceful

---

The No-Ditch Section in Cuts (see oposite page)

Construction scars can be ameliorated through the adoption of the no-ditch section, which eliminates one of the most common disfigurements along the highways—the steep side-slopes of raw earth cuts.

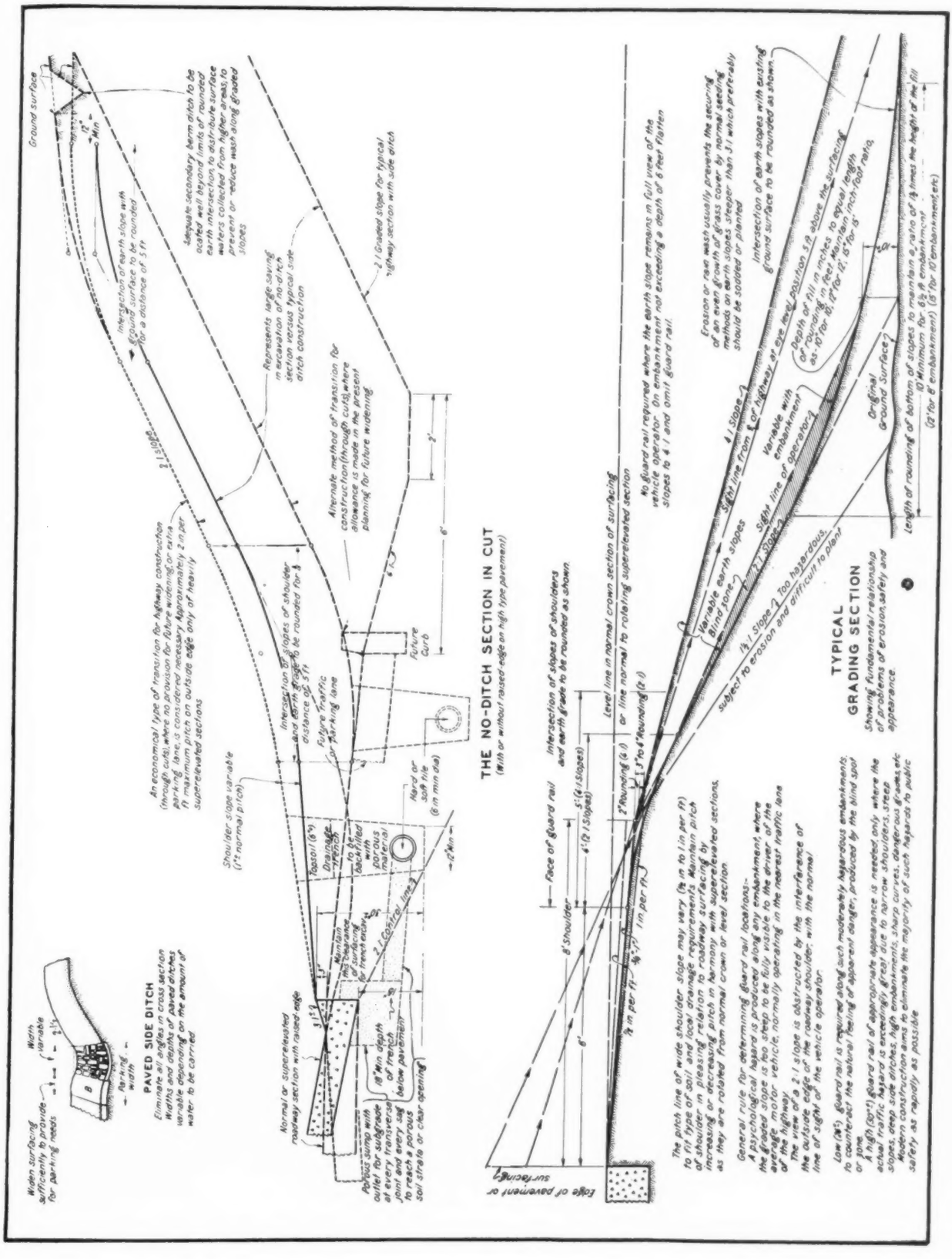
A summary of the permanent benefits follows—
The volume of excavation is considerably decreased.
The safety of traffic is effectively increased.
The erosion (and cleaning) of side ditches is eliminated.
The cost of highway maintenance is reduced.
The general appearance of the highway is appreciably improved.

Alternate paved side-ditch section for types of surfacing where raised edge is not used (see "B" at upper left).
Trench for subdrain where needed to bottom of seepage layer in stratified soils (depth variable).
Omit topsoil cover and backfill trench clear to surface with coarse material where surface water is to be collected.
Intercepting cut-off drains may be omitted entirely where lack of seepage and porous (sand or gravel) type of soil do not warrant the construction.
Location and appearance of outlets for the primary subsurface and the secondary surface water drains to be carefully considered.

An ugly borrow pit transformed into a useful, well-graded turn-out. It needs appropriate planting to remove the raw scars of construction to make it attractive as well as useful.

This turn-out takes advantage of a natural widening in the topography. Vines planted as ground cover will soon conceal the newly graded island division separating this parking space from the traveled roadway proper

Employment and Permanent Advantage



habit, and low or prostrate ground cover types, whether the ground cover selection in particular situations be vine planting, sodding, or grass or wild flower seeding.

Rigid Standardization Monotonous and Undesirable

It is not practicable to formulate detailed rules regarding landscaping and planting. Such work on the roadside will be in an almost undeveloped field where much improvement in methods and practices may be expected, and where progress should not be retarded by excessive standardization. In fact, it is doubtful if detailed standardization will ever be desirable, since variety and change are the essence of roadside charm.

(To Be Continued in the May Issue)

Notes Relative to Illustrations Below

On cultivated land, erosion takes place on hillsides of approximately 15% or more slope. The land use conservation policies of the United States Department of Agriculture recommend terracing marginal lands, with a slope of 15% or steeper, if they are to be retained economically in cultivation, otherwise such lands should revert to a vegetative cover of pasture or forest, so that the roots of the trees and secondary undergrowth or grasses, may prevent wasteful erosion.

Similarly, erosion along the through highways may be prevented by seeding, sodding, or planting the shoulders and slopes, as the final part of a comprehensive roadside improvement program.

In reducing erosion, the annual cost of maintenance is correspondingly decreased and the safety and general appearance of the highways as a continuing investment proportionately increased.

To eliminate the hazard of soft, eroding roadway shoulders, thoroughly prepare newly graded raw earth roadside areas, by adding loam (topsoil) and fertilizer, to assure the quick establishment, and economical maintenance, of a consolidated vegetative growth of grass or other appropriate ground cover planting.

On embankments the line of sight of the vehicle operator over the edge of the roadway (8′) shoulder is on a slope of approximately 3:1 as shown above on the right.

The bottom of any slope steeper than 3:1, therefore, is hidden from view. The blind spot resulting from a 2:1 slope produces a mental driving hazard, which explains and justifies the psychological need for guard rail.

Slopes flatter than 3:1 remain in full view of the highway user.

The 4:1 slope section on the left shows the clear angle of vision afforded to the bottom of the slope, which eliminates the psychological need for guard rail.

Earth slopes flatter than 3:1 thus conserve highway expenditures.

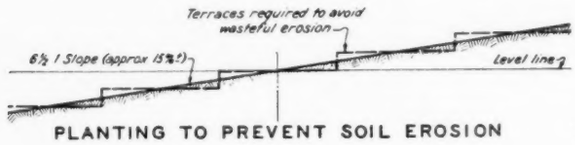
Flattening the slopes and side ditches in earth graded highway sections:

1. Reduces or entirely eliminates loss by erosion.
2. Simplifies initial operations of seeding and planting.
3. Decreases annual cost of necessary maintenance, and increases inherent safety, and general appearance of the basic construction.

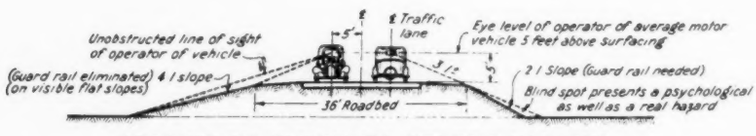
As a general conservation policy, the right of way should be widened to 150 ft. or more through wooded areas or other places of special scenic value, to enable the highway authorities to preserve and protect trees or similar features having unusual landscape interest.

Where existing specimen trees, or groups of trees, are located within the desired slope, slight modifications through careful adjustment in grading may often be made by steepening the slopes at such local points to avoid filling material around the trees.

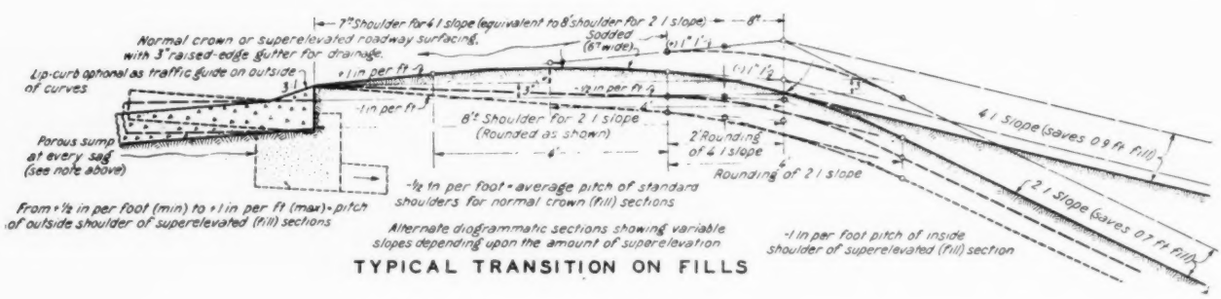
Tree wells, etc., may be combined with this conservation policy in saving specimen trees of outstanding value.



PLANTING TO PREVENT SOIL EROSION



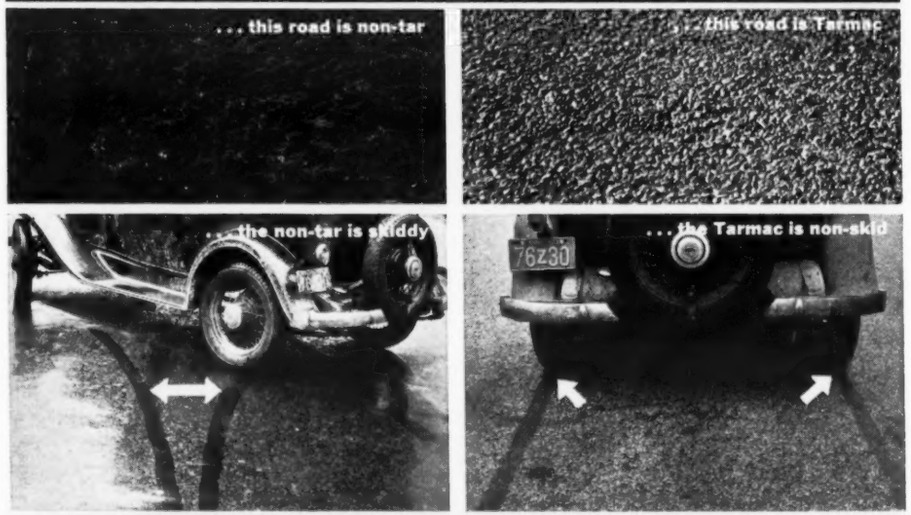
GRADING TO ELIMINATE TRAFFIC HAZARDS



TYPICAL TRANSITION ON FILLS

ALL BITUMINOUS ROADS ARE NOT THE SAME

THESE ARE BOTH BITUMINOUS ROADS, BUT . . .



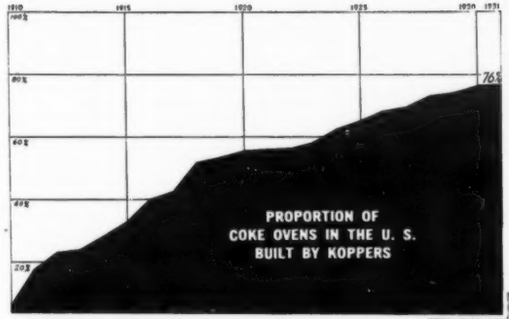
. . . with the non-tar there is poor penetration by the bitumen

(Laboratory test of penetration of non-tar into compacted limestone dust.)

. . . with the Tarmac there is complete penetration

(Laboratory test of penetration of Tarmac into compacted limestone dust.)

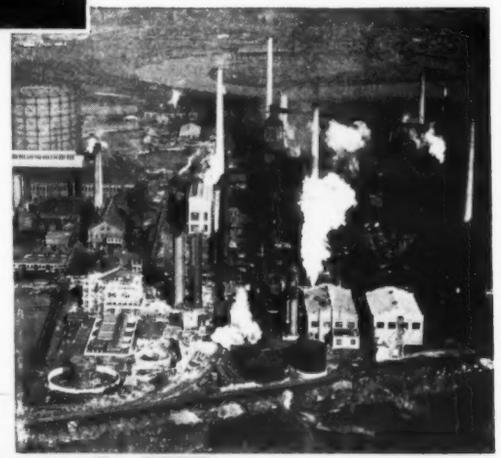
. . . FOR BEST RESULTS DEPEND ON TAR



But All Tar Producers Are Not the Same . . . For Best Results Depend on

KOPPERS **Tarmac**

COAL tar is produced by carbonizing bituminous coal in coke ovens. More than 75% of all these ovens in America were built by the Koppers Company, parent company of the Tarmac organization. The experience gained by this company in the development, construction and operation of thousands of ovens has given the company a grasp of every phase of the business of producing and refining tars to meet specific needs. For better tars, rely on Koppers.



ONE OF THE HUGE COKE PLANTS BUILT BY KOPPERS—Aerial view of the plant of the Massachusetts Gas Co., Everett, Mass.

A SMOOTH, DUSTLESS SURFACE MADE FROM A LOOSE GRAVEL ROAD—Mississippi State Highway Route No. 78 near Tupelo, carrying 1,000 vehicles a day after Tarmac Mulch Treatment. This surface formerly contained a high percentage of floating material.

KOPPERS PRODUCTS CO.
KOPPERS BUILDING, PITTSBURGH, PA.

Other Products:
Creosote—Roofing—Waterproofing
Dampproofing—Traffic Paints—Tar Paints

KOPPERS NRA **Tarmac**

When writing, we will appreciate your mentioning PUBLIC WORKS

Fig. 3—A series of Frost Heaves of a Gravel Surface

Fig. 4—Prominent Heave in a Gravel Surface

Frost Heave in Highways: Its Occurrence and Prevention

THE occurrence and amount of frost heaving is affected very considerably by the subgrade soil characteristics. The effect of heaving upon a road surface differs with the type surfacing. The latter is to be considered in deciding upon the necessity of preventive measures; the former in selecting and designing the preventive measures most desirable for the road in question. The subject has been studied by the Division of Tests of the Bureau of Public Roads, especially the methods used to prevent harmful frost action and the results obtained. To correlate the various methods employed, the Bureau of Public Roads, with the cooperation of the highway departments of Minnesota, Wisconsin and Michigan, conducted a survey during the period from 1928 to 1933 to determine for specific cases (1) the method of treatment used, (2) its performance under service conditions, and (3) the physical properties of the subgrade soils in the location and their arrangement in the soil profile. The following is slightly condensed from the report of this study prepared by the Bureau and appearing in its official publication "*Public Roads.*"

Effect on Various Pavement Materials

Rigid pavements are heaved and crack in excessive amounts but usually settle back in place after the frost leaves the ground. Successive heaves are often sufficient to break up long slabs of the thinner pavements to such an extent that replacement is required. In semi-rigid pavements the cracking and breakage due to one period of frost may require considerable patching, if not replacement.. Low-type wearing courses, such as gravel, are often entirely lost after one season, the gravel mixing with the soft undersoil without furnishing stability.

Fig. 1—Abrupt and Hazardous Frost Heave of a Concrete Pavement

When heave occurs abruptly there results a hazard to traffic. It is not uncommon for short sections of pavement to heave 10 or 12 inches above the adjacent surface, thus becoming an obstruction capable of causing fast-moving vehicles to leave the road.

Rigid and semi-rigid pavements may adjust themselves during thaws so that traffic is carried without resorting to special construction. Frost heaved sections of gravel roads are apt to became soupy mud, impassable to any type of traffic during thaws, rendering the entire highway unsuitable for traffic for a period of several weeks during the spring and thus tend to isolate the towns located along the highway.

Influence of Soil Profile on Heaving

Before considering the results of the preventive measures, it is advisable to discuss the different soil profiles found in this survey and their influence on heaving.

In many sections of the country a road surface rarely rests on a uniform subgrade for any great distance. This is due to two reasons.

(1) The grade line frequently intersects a number of layers of the soil profile depending on the depth of cuts, and the several layers, often differing in their physical characteristics, will each in turn form the subgrade of the road.

(2) An individual soil layer may possess such variable characteristics as—

(*a*) Pockets of soil material differing greatly in properties from those of the remainder of the layer.

(*b*) Stratifications within the layer.

(*c*) Depressions in the profile of the layer boundaries which act as reservoirs for the collection of water in excessive amounts.

(*d*) Variation in the ground-water elevation due to the topography of the adjacent area.

Differential heaving of pavements productive of dangerous traffic hazards is generally due to variations in the soil profile. Figure 2 shows the different types of soil profiles in which the preventive measures described in this report were installed. Profiles *B, D, F, G, I, J,* and *O* were furnished by W. I. Watkins of the United States Bureau of Chemistry and Soils.

Figure 2-*A* illustrates the type of soil profile productive of the heaving shown in the photograph figure 1. The pockets of silt and silty clay (group A-4 soil) varying in shape and depth occur within a deposit

of porous sandy soils (group A-3 soil). The heaving in the silt pocket is excessive while that in the surrounding sandy soils is negligible. Considerable heave occurs also in the pocket of silty clay. However, it is covered by an appreciable layer of sand (about 18 inches) which reduces the effect on the surface.

Figure 2-*B* shows a typical soil profile in the loessial area of Minnesota and Wisconsin. The frost heave is confined to that portion of the road resting on the unweathered or slightly weathered structureless silt. The weathered upper layers of the profile are granular in structure and apparently do not suffer detrimental frost heave.

According to the results of laboratory tests performed on representative samples of the various layers of the profile (fig. 2-B) the weathered silt loams and the structureless silt possess physical properties common to the group A-4 soils, while the underlying clay possesses the physical characteristics of the group A-6 soils.

The structureless loessial soil is a silt or silt loam containing a high percentage of very fine sand, has a high water-holding capacity, is unstable when wet, and possesses capillary properties in a high degree. Resting on a relatively impervious clay which retards percolation and forms a water table at its base, a condition is created favorable to strong functioning of the high capillary properties of the structureless silt layer. The clay may be at a considerable depth below the road surface and not necessarily in as close proximity to the surface as is indicated by figure 2-*B*. Figure 4 is characteristic of the type of heaving produced under the above conditions.

An example of detrimental frost heave in a sandy soil is illustrated in figure 2-*C*. The sand which varies from fine to coarse in texture and possesses physical properties indicative of the group A-3 soils is maintained in a saturated condition by a water table close to the surface. This is due largely to the topographic features of the adjoining terrain. The road cuts through small knobs or ridges, interspersed with bogs located both at higher and at lower elevations than the roadway. Figure 3 is an example of the heaving produced in such a case.

A soil profile in extremely variable glacial materials is illustrated in figure 2-*D*. The relation between frost heave and the various layers of the soil profile is similar to that described for figure 2-*B*. In this case the heaving occurs in an unweathered glacial till containing lime, sand pockets, and stratified sand and silt. Water is transmitted to the roadway by the capillarity of the glacial till and also by the stratified sand and silt. Considerable amounts of water collect in the sand pockets. The unweathered glacial till layer is essentially a group A-4 soil. However, it includes strata and small pockets of sand which possess the physical properties of the group A-3 soil. Such variations within a soil layer are especially productive of differential frost heaving.

Figure 2-*E* is an illustration of a soil profile in which heaving occurs as a result of depressions in the surface of an impervious clay. The dense clay restricts percolation of water and maintains the overlying sand in a wet condition while the sags in the surface of the clay layer act as reservoirs for the collection of water in excessive amounts. This condition is productive of the type of heaving shown in figure 1 and attributed also to condition 2-*A*.

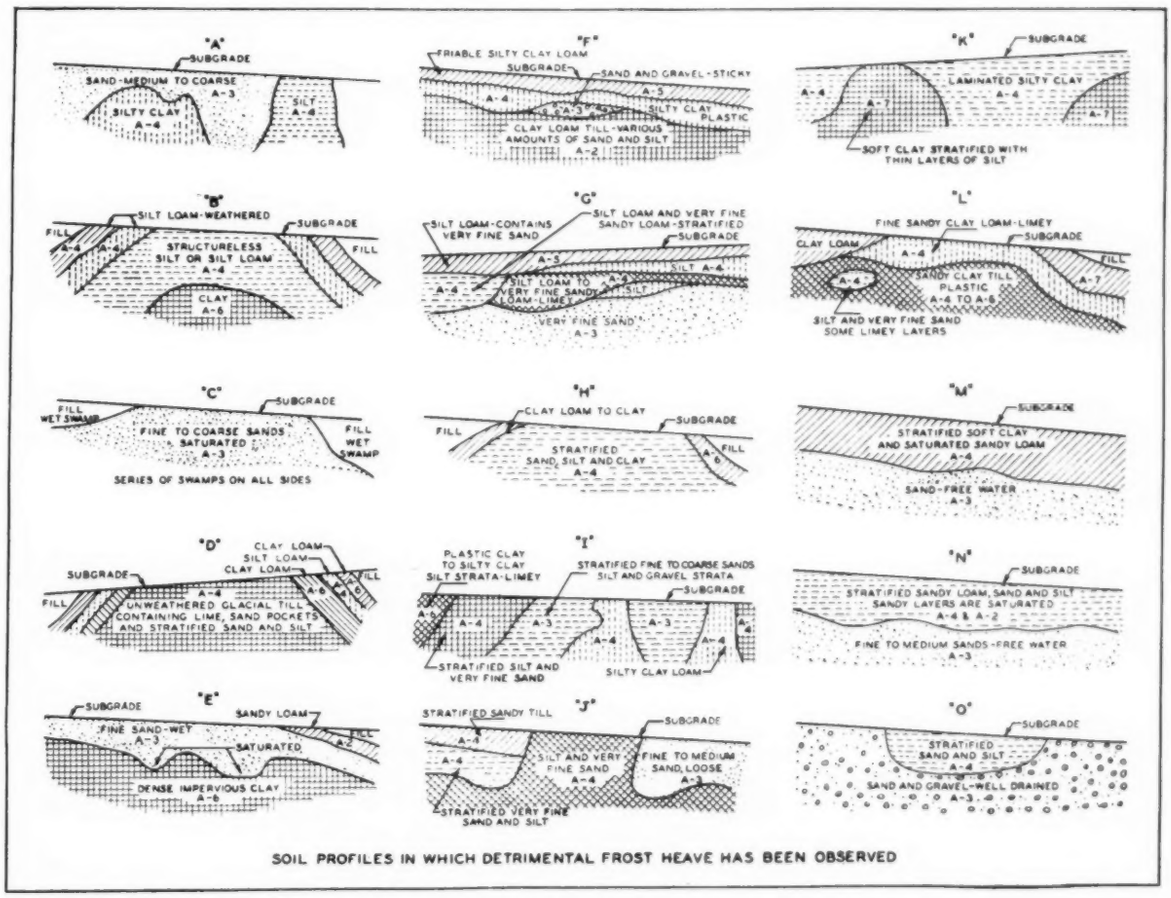


FIG. 2—*Soil Profiles referred to in the accompanying report*

In figures *2-F* and *2-G* the profiles consist of a surface layer of more or less unstable A-5 soil underlain by silts and very fine sands (group A-4 soils) which occur in pockets and layers of varying thicknesses adjacent to water-carrying soil layers.

Figures *2-H*, *I*, and *J* illustrate profiles which produce the greatest and most dangerous heaving. Stratified silt and very fine sand (group A-4 soil) invariably heave in such amounts as to rupture any type of superimposed road surface. Very dangerous differential heaving is produced when soil layers subject to detrimental heave in varying amounts are arranged in pockets as in figures *2-I* and *2-J*.

A different type of heaving condition is shown in figure *2-K*. The laminated silty clay possesses physical characteristics of the group A-4 soils and performs in the same manner as the A-4 materials previously described. The group A-7 soil, however, is not generally subject to heaving. In this profile it includes very thin layers of silt which assist in keeping the clay very wet and soft.

The majority of the clay loam soils similar to those shown in figure *2-L* are subject to detrimental frost heave only when wet and poorly drained but considerable heaving has been observed in fine sandy clay loam (group A-4 soils) containing appreciable amounts of disseminated lime. Where the road surface rests on lime-free clay loam of the group A-7 soils no serious damage has resulted.

The detrimental results of lime accumulations in a soil layer have been observed also in soil profiles where a limey clay loam of the group A-7 soils was found. Two adjacent clay loam soil layers in the same road cut were found to possess similar physical properties but the one containing lime heaved excessively while the layer free of lime did not heave enough to damage the road surface.

The soil profiles illustrated in figures *2-M* and *2-N* produce heaving similar to that of the stratified soils previously described and need no further discussion.

Differential heaving is certain where there is the extreme variation in soils as shown in figure *2-O*. The pocket of soil subject to frost heaving is composed of strata of water-bearing sand and strata of silt which absorb water readily and resist all attempts at drainage. The sand and gravel (A-3 soil) surrounding this pocket is well drained and does not permit the accumulation of water, and no heaving occurs in the sand and gravel.

Preventive measures will be described and discussed in the May issue.

Pages 53, 60 and 61 contain descriptions of many helpful booklets—Don't forget to look them over.

A 20-foot oil-mix mat in the country—no more dust on the roadside vegetation

Pre-Mix Bituminous Roads—Basic Factors in Construction and Some Cost Data

By J. N. Roherty

Research Engineer, North Dakota State Highway Department

DURING the past five years North Dakota's low-cost bituminous road surfacings have been constructed almost entirely of oiled gravel of the dense graded type. The climatic, soil, traffic and aggregate conditions are all favorable to this type and it therefore has been given the most study, and several inexpensive refinements have been introduced that are not generally employed in other states.

Because these low-cost surfacings look like the more expensive ones of higher type, there has been too much tendency to feel that the job is good if the surface looks and rides well when new; but such is not necessarily the case. If the subgrade is poor or the base weak or the aggregate poorly graded, traffic will find these weaknesses; and where subgrade or base fails, the public will probably erroneously lay the blame to the bituminous surface. In preparing the subgrade and base as well as the surface, low-cost roads require the highest type of engineering skill.

Too often, because comparatively little money is spent on constructing low-cost roads, little engineering thought is given to them; and the result is seen in failures, which are due solely to poor design and workmanship but are commonly attributed to the type and used as an argument for high-type expensive roads. Many miles of the latter are in use today where traffic could be served almost as well with a surface costing only one-fourth as much.

Given a properly constructed subgrade and base, the next important step is the gradation of the aggregate to be used. This is as important in oil-gravel and other low-cost bituminous surfaces as in portland cement concrete or sheet asphalt. When portland cement first came into general use, pit-run gravel was thought good enough, but we now know that by properly grading the aggregate a stronger, denser, cheaper and more durable concrete is obtained. Similarly, in the early days of the asphalt industry any sand that looked good to the eye was considered satisfactory for sheet asphalt, but Clifford Richardson proved that poor grading of aggregate was the cause of almost all failures—and some failed completely in a few years or even months.

The same evolution is found in the development of oil-mix pavement, which is coming into use in a large portion of the country. Some engineers think that any old gravel is good enough for this, but others know that for good results the aggregate must be properly graded and that it will pay to do so. Road oil is not so

Above: Spreading the mixed material on the primed base. Below: A traffic-compacted 24-foot mat

Second Step—Spreading the mixed material

stable a bitumen as is paving asphalt and in an open mix will readily be attacked by oxidation and water. The Asphalt Institute lists oil-gravel mix as a graded aggregate type of surface, in which the aggregate should be well graded from coarse to fine; and "well graded" means the same for this as for portland cement concrete or sheet asphalt.

The simplest way to analyze the grading of an aggregate is by plotting a grading curve. North Dakota uses a sheet with the size of screen as ordinates and percentages of total aggregate as abscissa, a logarithmic scale being used for screen sizes and a uniform scale for the percentages passing. (See *Public Works* for November, 1932.)

The least stability in an aggregate occurs when the particles are all of the same size and rounded. A predominance of any one size in a gravel indicates lack of stability. Maximum stability occurs when we have a straight line grading, for then we have maximum density. By plotting a curve of the grading, we can see at a glance whether or not we have a good grading. A predominance of any one size will show up plainly and at the same time we can see just what must be done to correct the grading. If more than one source of aggregate is available, the best one can be seen at a glance. The best grading will sometimes require the use of aggregate from more than one source or, where a pit is variable in grading, the best combination can be worked out. This should be done, and can be done usually with very nominal expense. If previous experience is worth anything, all the indications are that it will pay well and the engineer who does not get maximum worth, within economic limits, out of all the products he works with, is just in that measure falling down on his job.

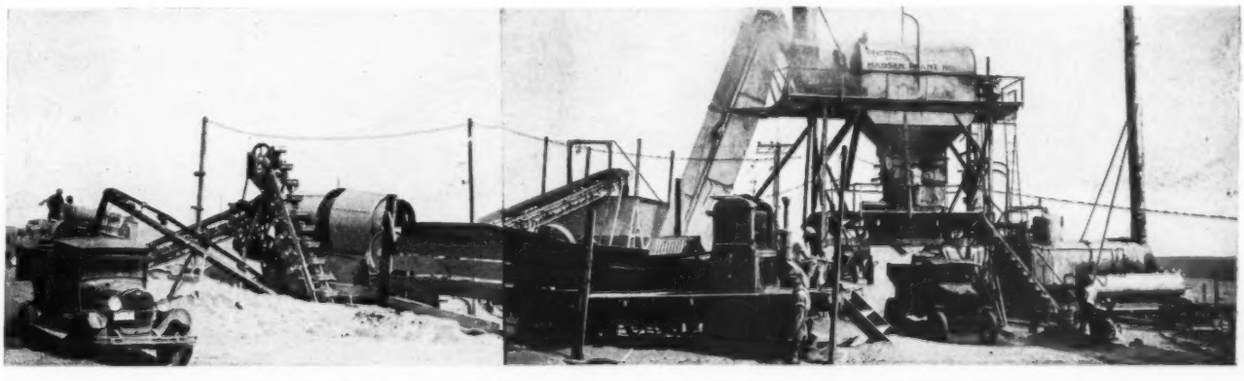
The straight line grading has been pretty definitely determined as the ideal grading for a dense aggregate. This requires grading clear down to the 200 mesh material or lower. The survey of sheet asphalt showed that better results were obtained when the filler contained the proper portions of material even finer than 200 mesh. As screens can not be satisfactorily used below this size, these smaller fractions can be determined by stirring the filler in water and observing the time of settlement. To the layman the addition of filler looks like putting in just so much dirt, but the engineer knows that it is just as essential as any part of the mixture, if not more so, and it isn't just dirt. It may be a silt, but it must be of such a nature that it will mix readily and also hold the bitumen. If it will ball up in the mixing, it shouldn't be used, as it is impossible to incorporate it uniformly into the mix. There are fillers that mix readily, but which will not hold the oil; especially in the presence of moisture. As this quality can be pre-determined, such a filler should not be used. The fineness and amount of filler to be used will depend on the grading of the sand fraction, especially down on the 80 and 100 mesh screens. If the gravel is deficient in these sizes the filler should make them up.

Grading the aggregate is not expensive and the analysis of the grading is a simple matter. The grading should be corrected as much as possible within economical limits. Screening equipment for the removal of oversize will be required on nearly all jobs. The additional screen and bin equipment required is usually inexpensive and better results are sure to result from a well graded aggregate.

To some it will probably seem that adding these refinements is too costly for the benefits derived, but we do not feel that we can afford to slight details that make for a better job. Costs which are given below I think will substantiate our claims. All of our work of any size is let by contract, as we have found that this too is economy, but we try to eliminate so far as is possible the uncertainties from the items bid upon and for which the contractor must bid safe.

The state furnishes the pits from which the aggregate must come. These pits are thoroughly tested and the contractor knows just how much oversize the pit contains and he also knows what will need to be done to get a satisfactory grading. The filler pit also is furnished by the State, and the contractor is told how much must be used to get the desired grading in the mix. The oil used is bid upon separately and the contractor is paid for the actual gallonage used. Our engineers design the mix, and the contractors' profits are dependent on how well he can organize his crew and efficiently perform the items of work specified and bid upon.

Our work is almost exclusively plant mix. Plant mixes



A Blaw-Knox Madsen plant which averaged almost 100 tons of mixed material per working hour

in our latitude permit of a longer working season, give absolute control of the mix and permit the use of a better or higher viscosity oil. All plants are equipped with dryers and weigh batchers in addition to the screens and crushers. Some plants are equipped with a separate smaller dryer for the natural soil filler which we use. This is apparently a saving as it gives greater capacity to the sand and gravel dryer and lessens loss of the filler in going through the big dryer and out the stack.

Our plants have pugmill mixers and handle from 2,000 lb. to 4,000 lb. batches, but the plants with 4,000 lb. mixers usually process about a 3,000 lb. batch or a little over that amount.

An efficiently operated plant turns out a batch per minute. On Federal Aid Project No. 84 north of Minot, North Dakota, a Blaw-Knox or Madsen plant operated by Megarry Bros. placed 15,800 tons of mixed material in 159 working hours. The contract price on this project was $1.73 per ton in place on the road. This price does not include the oil. The oil was paid for separately and amounted to about $1.00 per ton. The price of $1.73 included drying, screening mixing, hauling (an average distance of 6.4 miles) spreading, and maintaining until compacted by traffic. The filler was hauled from a different pit about three miles from the plant. The above price also included hauling the oil from the railroad to the plant, a distance of three miles. The pit contained sufficient coarse aggregate after the oversize was rejected. The rejection of the oversize was also included in the above price of $1.73.

On F. A. P. No. 306 A, the contract price was $1.37 per ton in place This price included the screening and crushing (about 11% oversize), drying, mixing, hauling an average distance of about two miles spreading and maintaining until compacted by traffic. On this project, the plant moved out on the 15th day after it started operating, after mixing and placing 12,500 tons of material. One-ton batches were mixed on this job.

On F. A. P. 55 near Jamestown, North Dakota, the contract price was $1.10 per ton in place. This price included screening, crushing (about 10% oversize), drying, mixing, hauling an average distance of about 3.8 miles, spreading and maintaining until compacted by traffic. On this project, a railroad spur and water tank existed at the pit and there was no haulage on oil. The above price does not include the oil. The mat on this project was 24 feet wide.

With such prices, we do not feel that an equally good product can be obtained for the same cost by any other method.

We can construct, maintain, and even reconstruct when necessary, such roads for less than the interest on the amount of money needed to construct a concrete road twenty feet wide, and so long as we can carry our traffic on a wide, smooth, dustless highway like this for less than the interest on a high-type road we consider it good business to do so, as the traffic advantage of a high-cost road over this type is almost nil.

Blue Prints

The blue printing machine has operated almost continuously during the year, taking care of printing all plans and special work. A total of 470,000 square feet has been printed at an estimated saving of $4,700. In addition to the saving in money, there is also a great saving in time by having prints made quickly as they are needed. A large amount of work has also been done by the Photostat machine at a saving in cost and great convenience.—*Annual Report, Georgia Highway Department.*

Resilient Expansion Joint Fillers Tested

EFFORTS have been directed within the last few years toward the development of a resilient expansion joint which would absorb expansion of the concrete without appreciable extrusion of the filler and also expand upon subsequent contraction of the concrete, thus keeping the joint filled. A number of materials for filling expansion joints have been developed which manufacturers claim will produce these results. These materials have been tested by the Division of Tests of the U. S. Bureau of Public Roads to determine to what extent they meet these requirements.

The samples tested included four brands of sponge rubber filler; one of cane fiber impregnated with an asphaltic compound; one of a compound of asphalt and fiber with particles of vulcanized rubber; one of granulated cork bound with phenol formaldehyde resin; and one of a compound of asphalt and finely ground vulcanized rubber. An effort was made to duplicate as closely as possible the conditions to which joint fillers are subjected in actual service, including compression for varying lengths of time and weathering. Each sample was compressed to one-half its original thickness and pressure removed, and this repeated twice more, with one-hour recovery periods between; the amount of extrusion being measured, and the extent of recovery to original thickness. Samples were exposed to weather for 3, 6, 9 and 12 months and then tested as above. Also, absorption tests were made.

From these tests it was concluded that the perfect expansion-joint filler is yet to be developed. None of the materials tested show all of the qualities desired in a filler.

Of the materials tested, the sponge-rubber and cork fillers appear to combine to the highest degree the features of resiliency, durability, and resistance to extrusion which are considered desirable in expansion joint fillers. The chief question regarding the sponge-rubber filler is the probable service life of the material. One year's exposure to the weather failed to cause any apparent change in the characteristics of the sponge rubber. However no definite information is available beyond this period. No conclusions can therefore be drawn at this time regarding the relative durability of fillers of this type.

The cane or vegetable fiber filler possesses the best resistance to extrusion of any material included in this investigation. It is not very resilient and cannot be considered as efficient from this point of view as either sponge rubber or cork. Although the fiber joint is easily damaged by frost action, tests on frozen samples show no appreciable loss of resiliency. It is possible that, after the material is installed, frost action would have little deleterious effect on its performance.

Information obtained from various sources indicates that changes in length of as much as one quarter inch may be expected in a 40- to 50-foot concrete slab due to variations in temperature and moisture content. These tests indicate the desirability of using 1 inch of cork or sponge-rubber filler for each 40- to 50-foot slab if it is desired to make allowance for the maximum expansion which may occur and at the same time have the joints tightly filled with desirable material.

The asphalt-rubber fillers appear to be the least desirable of the materials studied. These fillers show relatively little resiliency and have large amounts of extrusion. In these respects they are little better than the plastic asphaltic joint fillers.

For the Road Builder

A Cold-Lay Bituminous Paving Mixture

By means of specially designed equipment, mineral aggregate can be conditioned at the quarry or pit, by thoroughly drying, screening and grading to meet any specifications, and impregnated with an asphaltic waterproofing compound. After this treatment, it is stated, no moisture can ever again enter the aggregate, which can be stored in convenient piles for subsequent coating with asphaltic cement to produce a finished paving mixture. Or the asphalt cement can be added in the original operation and the mixture shipped in open-top cars, ready for use without any further preparation.

This paving mixture—called Sealdrok—does not set up or become hard while in transportation, and is easy to unload and handle. Its use does away with many of the problems of low-cost road construction, including the drying and conditioning of the mineral aggregate. Illustrations herewith show various features of this paving mixture.

Further information regarding the process, the equipment, costs and advantages can be obtained from the American Sealdrok Corp., 43 East Ohio St., Chicago, Ill., which is a subsidiary of the American Asphalt Paint Co.

For Faster Handling of Loads:

The "Hustler" general utility crane, just announced by Harnischfeger Corp., Milwaukee, Wis., is designed primarily for faster handling of loads, whether on pipe work, or as a clam, drag-line, pile driver or other service. Speeds in motion up to 5.2 mph. With counterweight, this machine carried 12,000 pounds at a distance of 6 feet from the edge of traction; without counterweight, it picked up 5,200 pounds 4 feet from the edge of the crawler and traveled 5.2 mph with it; with a detachable stiff-leg under the boom, it will lift 35,000 pounds.

The Hustler Crane is adapted to modern highway construction

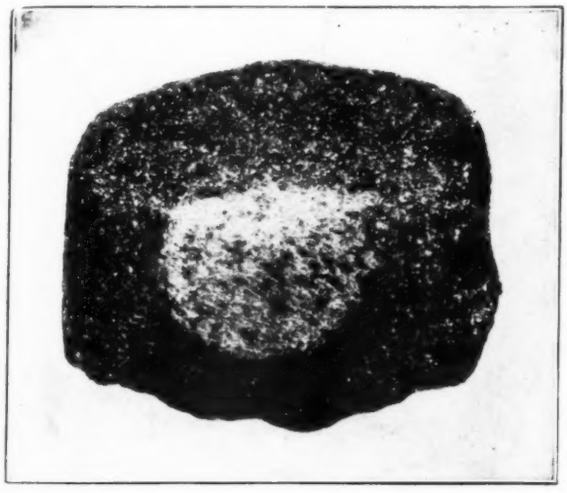
New Type of Delay Blasting Cap

A new all metal delay electric blasting cap, unusual in design, has been announced by Hercules Powder Company.

The outstanding features of the new detonator are the firing and delay elements that produce practically no gas when burning. These features make possible the use of a solid, one piece, ventless shell.

The new delay cap, having no hot gas, cannot cause ignition of the dynamite. Needing no gas-escape openings in the shell, no moisture can enter, a usual cause of misfires in other types of delays.

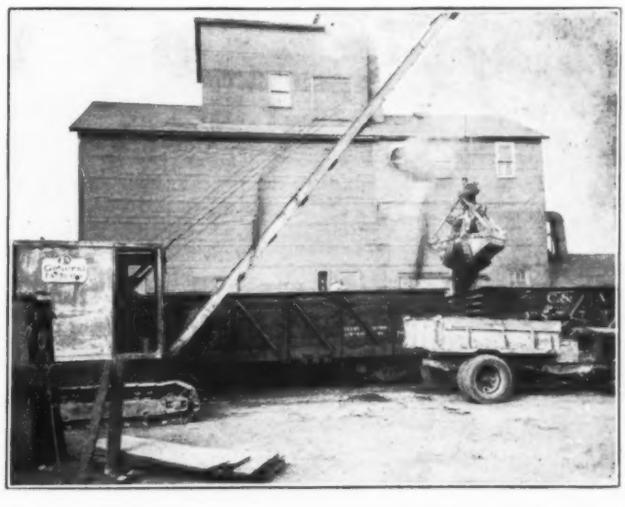
Hundreds of thousands of the new delays have been tested in the field with unvaryingly satisfactory results, according to Hercules explosives authorities. U. S. patents have been applied for on this new cap and are pending at this time.



The illustration at the left shows how thoroughly the Sealdrok process penetrates the aggregate. Lower right shows how easily Sealdrok handles after shipping in open cars. Lower left shows men at work on the highway placing Sealdrok.

Asphaltic Road Material Specifications:

The specifications for liquid asphaltic road materials presented in this pamphlet have been developed as the result of conferences with representatives of the Bureau of Public Roads and the various state highway departments. They superseded former specifications 1 to 7, inclusive, of the Asphalt Institute. Sent on request to PUBLIC WORKS or to Asphalt Institute, 801 Second Ave., New York.



Pages 53, 60 and 61 contain descriptions of many helpful booklets—Don't forget to look them over.

Readers' Service Department

To help you in your work, any of this **INDUSTRIAL LITERATURE** will be sent **FREE** upon request.

IT is a good practice to check this list regularly because descriptions of new bulletins are always being added. ★

Road and Street Maintenance

Asphalt Heaters

8. Full information concerning their tar and asphalt kettles, surface heaters, oil burners and other road maintenance equipment will be sent promptly on request by Littleford Bros., 452 East Pearl St., Cincinnati, Ohio.

Asphalt Mixing Plants

200. For general construction and maintenance, the Original Improved "Hotstuf" Asphalt Heater, an economical oil burning heater. Mohawk Asphalt Heater Co., 56 Weaver St., Frankfort, N. Y.

Distributors

206. Kinney distributors of from 600 to 1,700 gallon tank capacity with heating system and the Kinney jacketed pump having a capacity of over 400 gallons per minute are described in a new catalog just published by the Kinney Mfg. Co., 3533 Washington St., Boston, Mass.

Dust Control

209. "3000 men put back to work in a single county." A new folder just issued by the Solvay Sales Corp., 61 Broadway, New York City, outlining a road program which is a relief program. Sent promptly on request.

210. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with dust control, road building and maintenance.

211. "Principles of Road Soil Stabilization," a new booklet just issued by The Columbia Alkali Corporation, Barberton, Ohio. Gives a clear, concise picture of what road soil stabilization is and how it can be accomplished.

212. "Wyandotte Calcium Chloride Prevents Dust the Natural Way,"—a publication, fully illustrated, treating on Dust Control, economical road maintenance and methods of application, issued by the Michigan Alkali Company, 10 E. 40th St., New York City.

Dust Laying

213. Full information regarding the use of Solvay Calcium Chloride for effec- Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, econtively laying dust. The booklet, "Solvay omies, etc. Sent without cost. Solvay Sales Corporation, New York.

Emulsion Sprayers

214. A complete line of emulsion sprayers is described in Bulletin No. G-5 recently issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio. Littleford Emulsion Sprayers will spray any type of asphalt emulsion used for penetration patch work or curing concrete. They are also used to spray silicate of soda and weed exterminators.

Mixed-in-Place

218. "Mixed-in-Place" bituminous road construction. The construction of low-cost, dustless, mudless roads in a new and better way with the Parsons "Turbo-Mixer." Full details sent promptly by The Parsons Company, Newton, Iowa.

Surface Heaters

220. The "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is described and its use illustrated in Bulletin 16. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Oil Mix Roller

222. "Rolling Oil Mix with Rubber" is the title of a new circular illustrating and describing the Bros rubber tired Oil Mix Roller which is designed to quickly compact the surface of fresh or disked oil mix pavements and leave the surface in ideal condition for immediate use by speed traffic. Issued by Wm. Bros Boiler and Mfg. Co., Minneapolis, Minn.

Sweepers

223. A universal sweeper, especially adapted for the sweeping requirements on re-tread, black top and oil treated paving contracts, is described and illustrated in a new circular just issued by The Frank G. Hough Co., 919 No. Michigan Ave., Chicago, Ill. This sweeper is for use with team, truck or tractor; has reversible brush and independent engine drive.

Noiseless Manhole Covers

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

Road and Paving Materials

Bituminous Materials

225. A comprehensive manual on the "Use of Emulsions for Street and Highway Construction and Maintenance," discussing types, uses, relative costs, construction details, etc., will be sent promptly on request by Headley Asphalt Division, Sinclair Refining Co., P. O. Box 66, Marcus Hook, Penna.

226. "Asphalt Surfacing Materials for Low-Cost Roads" is a handy, 28-page booklet illustrating the many types of road surfaces which can be constructed with Texaco asphalt materials. Well illustrated and contains tables of amounts of stone, sand and asphalt required. Sent promptly by the Texas Company, 135 East 42nd St., New York, N. Y.

227. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvialithic. 32 excellent illustrations.

229. A new series of concise and authoritative manuals of construction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Ave., New York. N. Y.

229A. Surface Treatment Types, Asphalt Road Construction Manual No. 2. Full details on surface treatments. 14 chapters, 128 pages. The second of those tremendously valuable and handy little manuals put out by the Asphalt Institute, 801 Second Avenue, N. Y. Sent on request.

Brick, Paving

230. Full information and data regarding the use of vitrified brick as a paving material, cost, method of laying, life, etc. National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. 47 pages. The Dow Chemical Company, Midland, Mich.

Gutters

240. "Brick Gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Jacking Culverts

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Maintenance Materials and Methods

270. "How to Maintain Roads," by the Dow Chemical Company, Midland, Michigan, is a manual dealing thoroughly with road building, maintenance and dust control.

275. "Tarvia-K. P. for Cold Patching." An instructive booklet illustrating and describing each step in patching a road with "Tarvia-K.P." 16 pages, illustrated, 3½x9. The Barrett Company, New York.

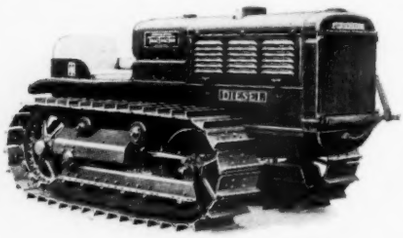
276. "Road Maintenance with Tarvia." A 56-page illustrated booklet of value to every road man. Shows how almost every type of road and pavement can be repaired and maintained with Tarvia. The Barrett Company, New York.

To secure any of the above, use the handy coupon on page 60 or write: Readers' Service Dept., care Public Works, 310 E. 45th St., New York, N. Y.

Six Items of Highway Equipment

Cranks Easily—Turns Quickly—Operates Economically:

This new model TD-40 is operated by a 4-cylinder diesel and has the same chassis as the McCormick-Deering 6-cylinder T-40; it is made by International Harvester Co. Easy cranking through reduction in cylinder pressure and the use of gasoline. In normal use the compression is 550 to 575 pounds per square inch. There are five speeds, from 1.75 to 3.0 miles per hour, and a 2.25 mph reverse. This diesel tractor has a maximum horsepower of 52 and drawbar horsepower of 44. It is especially suited for road-building and maintenance work, snow removal and bulldozing. It turns in a 7-foot radius.



Trackson TD-40

Hydraulic Steering Control for Rollers:

Hydraulic power steering control has been adapted to road roller use by the Hercules Co., Marion, O., who announce that their Model 100 ten-ton three-wheel roller is now so equipped. The turning of a small lever by the operator is all that is necessary to control the direction of the roller.

Hydraulic scarifier equipment—the most powerful yet developed, it is claimed—has also been announced. Another development of this company is the cast steel center rear roll. A cast steel spider forms the spokes in this two-piece wheel, and separate semi-steel rims of any desired width may be mounted thereon, thus making the roller adaptable to any type of work.

Easy to steer with hydraulic control

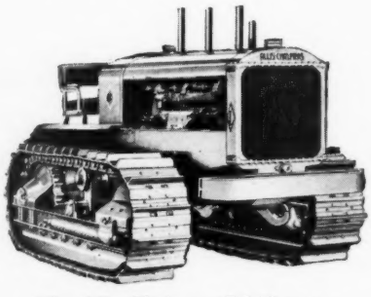
A Larger Tar and Asphalt Kettle:

A kettle for maintenance and repair work on highways, with a larger capacity, is announced by Littleford Bros., Cincinnati, Ohio. This kettle replaces their best seller, substituting a 50 to 75-gallon capacity, but retaining the double circulation, hot and cold material reservoir, and other features. The key number on this new kettle is 84-HD-1, and descriptions will be sent on request.

McCormick-Deering I-12 small industrial tractor made by the International Harvester Co.

A Small Industrial Tractor:

With speed range from 2.5 to 10.25 mph, this 21 hp industrial tractor covers a real field of usefulness. It is 96 inches long and easy to handle, while it has sufficient power to operate all sorts of lighter industrial equipment.



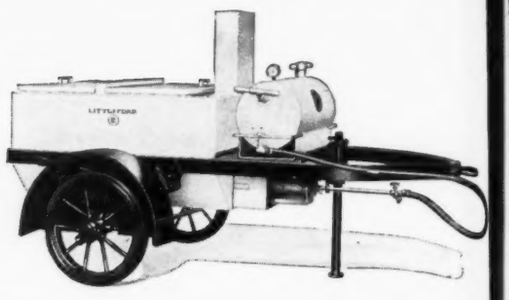
The Allis-Chalmers Oil Tractor

New A-C Oil Tractors:

Allis-Chalmers, in announcing the new "KO" and "LO" Oil Engine tractors, culminates over ten years of intensive study of engines that will burn cheaper grades of distillate fuel oil. These new engines burn any grade of commercial Diesel fuel that is within the limits of viscosity, free from sulphur, and clean. The best fuels from which the most efficiency will be obtained are commercial Diesel oils, grades 2 and 3. These new oil engines start by either hand cranking or electric starter. This is possible because of the low compression of the engine (125 pounds). No special starter or auxiliary engines are necessary.

Fuel oil is injected into the cylinders under pressure through the Bosch Diesel fuel pump and injectors. This fuel injection is positive and always controlled by the governor of the tractor. Ignition of the finely sprayed fuel oil is from the ordinary spark plug and magneto.

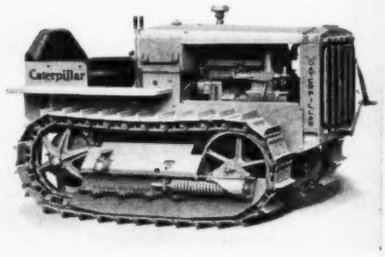
The weights of the "LO" and "KO" are 23,000 pounds and 11,200 pounds, respectively, in keeping with the horsepowers of the tractors.



New Littleford Tar Kettle

Triple Economy Twenty-two Tractor:

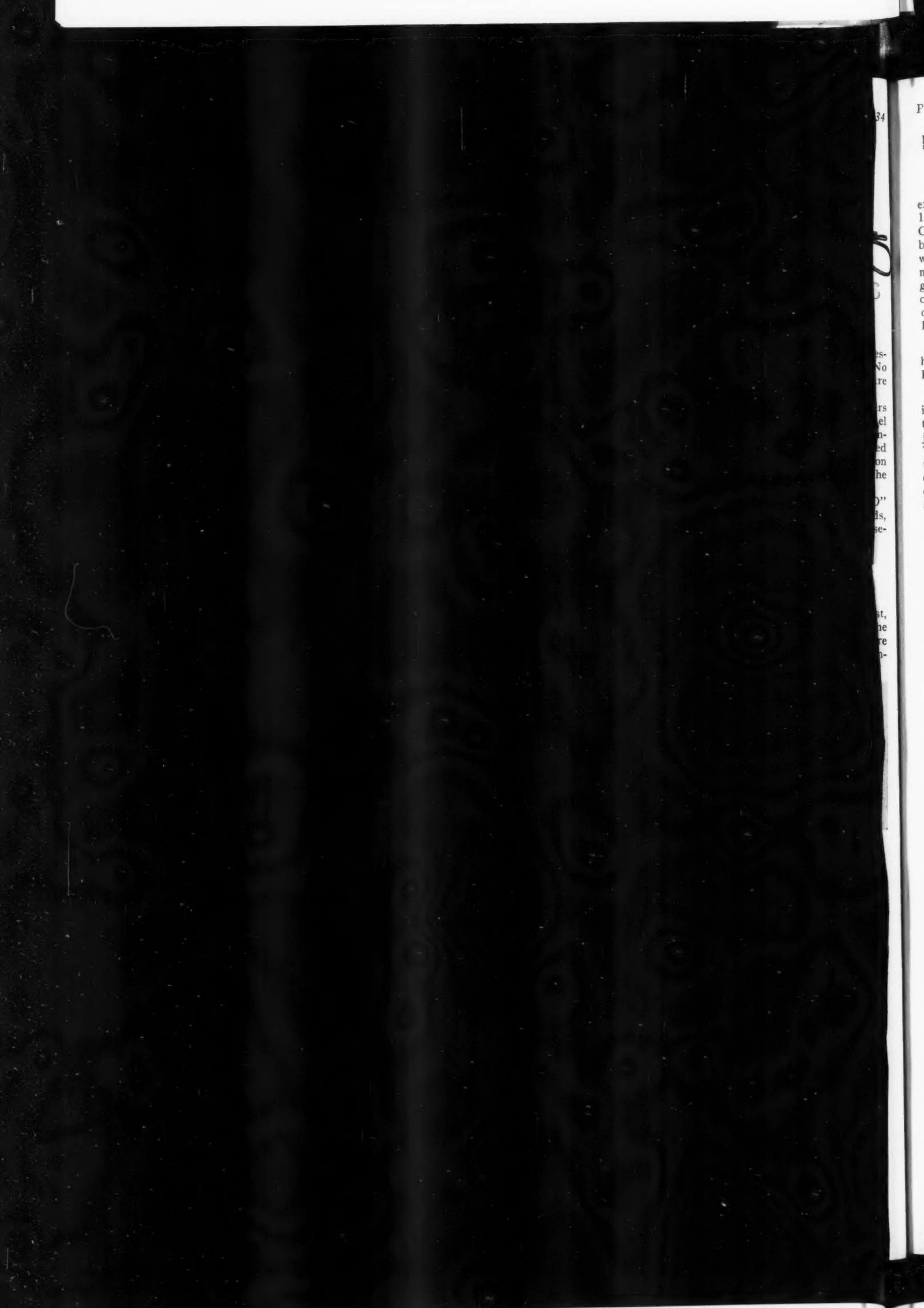
The triple economy of low first cost, operation on inexpensive fuels and the power savings of track-type traction are features of the new "Caterpillar" Twenty-Two Tractor, recently announced by Caterpillar Tractor Co. of Peoria, Illinois.



Caterpillar Twenty-two

The new model is powered with a four-cylinder, four-cycle, valve-in-head engine developed especially for converting a wide range of low volatility fuels into efficient, dependable tractor performance. The engine has a 4-inch bore and 5-inch stroke and develops a maximum horsepower of 23.69 at the drawbar and 28.39 on the belt at governed speed of 1250 r.p.m. Lubrication is force feed to all main, connecting rod and rocker arm bearings. A twin fuel tank holds 20 gallons of tractor fuel and 2 gallons of gasoline, which is used in starting, and a 3-way fuel control valve is located on the dash in easy reach of the operator.

The Twenty-Two is available in either standard or wide gauge models. The standard machine has a shipping weight of 6,150 pounds.



Readers Comment on C.W.A

Minnesota.—The CWA passed out of existence in this section on March 15, 1934. In summing up the results of the CWA, do not overlook the vital work of building men. . . . After their winter's work, the men are more fit, physically, morally and hopefully, to carry on. Regardless of some minor graft and inefficiency the CWA has been worth "the candle" in this community at least.—R. R. REILLY, *Civil Engineer.*

New York.—For God's sake advocate home rule on CWA expenditures.—H. J. HUBER, *Sup't of Public Works.*

Michigan.—The CWA work, as originally planned was too attractive, and the registraton in this county, where 830 jobs were available amounted to 2600. Those disappointed were vehement in their condemnation of the people handling the CWA, and wrote all manner of complaining letters to whatever agency they could find the address of. As soon as the hours of labor were cut to 15 and 24, this ceased and there is no longer any stampede for jobs.

We also found that the unemployable unemployed went to work first, due to the regulations, and these will be the last to be laid off. If it had been possible to use machinery, at least ten times as much work could have been done, and a crew of the same size could have been put to work.—H. E. CARLIN, *Superintendent.*

Southeastern Section, AWWA

The annual meeting of the Southeastern Section, AWWA, will be held at Augusta, Ga., April 10-12. The tentative program is as follows:

Tuesday Morning: Address of welcome by Mayor Thomas Barrett, Jr., of Augusta; address by H. C. Delzell, National Field Representative of the AWWA Recovery Committee. *Afternoon:* There will be an inspection trip to the city pumping station, head gates of the Augusta canal system, and filtration plant, followed by a Barbecue.

Wednesday Morning: T. E. P. Woodward, engineer of the Macon Water Department, "Reconstruction of the Riverside Pumping Station at Macon." Discussion by C. H. Hunnicut, the chairman of the Macon Water Works Commission. "Handling and Storage of Chemicals for Water Works," by L. L. Hedgepeth, Pennsylvania Salt Co. "Flow of Small Streams," by B. M. Hall, Jr., Engineer-Examiner PWA, Atlanta, Ga. A paper on Water Works Material Cost Trends will be presented by an author to be announced. *Afternoon:* "Regional and State Planning," by H. T. McIntosh, with discussion by J. Houston Johnson, State PWA Engineer, Atlanta. Round Table Discussion covering the following topics: Open vs Covered Reservoirs; Carbon Dioxide Removal and Corrosion; Design of Elevated Steel Tanks; Painting Waterworks Structures; Handling Consumers' Complaints. Superintendents Trouble Hour, with question box.

Thursday Morning: "Underground Corrosion in the Southeastern United States," by K. H. Logan, Bureau of Standards, with discussion by J. E. Gibson and W. N. Rapp. "Trends in Stream Pollution Research and Control," by J. K. Hoskins, U. S. Public Health Service, Cincinnati. "Description of Sewage Treatment Processes," by M. T. Singleton, consulting engineer, Atlanta, Ga.

Coming A.W.W.A. Section Meetings

April 11-13—Indiana Section — Memorial Union Bldg., Purdue University, Lafayette, Ind. Secretary, C. K. Calvert, R. R. 3, Box 976-H, Indianapolis, Ind.

April 20-21—Montana Section — Billings, Mont. Secretary, H. B. Foote, State Board of Health, Helena, Mont.

May 10-12—Pacific Northwest Section—Hotel Eugene, Eugene, Ore. Secretary, E. C. Willard, 720 Corbett Bldg., Portland, Ore.

August 23-24—Central States Section—Hotel Windsor, Wheeling, W. Va. Secretary, H. L. Nelson, United States Pipe & Foundry Co., 2437 Koppers Bldg., Pittsburgh, Pa.

September 17-19—Rocky Mountain Section, Santa Fe, New Mex. Secretary, B. V. Howe, State Board of Health, 437 State Office Bldg., Denver, Colo.

Other Meetings

April 18-19 — Third Annual School for Water Works Operators immediately preceding meeting of the Montana Section of the A. W. W. A.

June 4-8—Annual Convention of American Water Works Association, Hotel Commodore, New York, N. Y. Secretary, B. C. Little, 29 W. 39th St., New York, N. Y.

September 3-6—Annual Meeting of American Public Health Association—Pasadena, Calif. Willimina Rayne Walsh, Secretary, Committee on Meetings and Publications, 450 Seventh Ave., New York, N. Y.

Personal

A. G. Pratt, president of the Babcock & Wilcox Co., has been elected to the Board of Directors of the Wothington Pump and Machinery Corp., Harrison, N. J.

Clifford W. Ham and Carl H. Chatters of Chicago, and R. E. Lee Taylor of Baltimore have been appointed to the PWA Technical Board of Review by Public Works Administrator Harold L. Ickes.

Wilbur G. Hudson has been appointed chief engineer of the Link-Belt Company's Pershing Road Plant in Chicago. A Cornell graduate, Mr. Hudson has had a long and varied experience in construction and materials handling.

Stillman & Van Siclen, Inc., have removed their offices and laboratories to the 12th floor, 254 West 31st St., N. Y.

Everett Chapman has been elected vice-president of Lukenweld, Inc., a division of Lukens Steel Co., Coatesville, Pa.

Major W. A. Hardenbergh has been promoted to the grade of Lt.-Colonel, Sanitary Corps Reserve.

Material Prices

(March 20, 1934)

Prices on cast iron pipe, net per ton, Class B, 6-inch and larger, AWWA specification*

Boston	$45.50	Baltimore	$43.50
New York	42.90	Atlanta	40.00
Chicago	44.00	Birmingham	36.00
Minneapolis	46.50	Kansas City	46.15

Burlington, N. J., $40.00; extra price for 4-inch, $3.00 per ton; extra for class A, $3.00 per ton.

**Information, courtesy U. S. Pipe & Foundry Co.*

Warehouse Prices on Reinforcing Steel and Structural Shapes

	Structural Shapes	*New Billet Reinforcing Bars*
New York	3.27c	2.52c
Boston	3.42	2.73
St. Louis	3.34	2.815
Cincinnati	3.30	3.10
Pittsburgh	3.05	3.00
Chicago	3.10	—
Philadelphia	2.75	2.505
Cleveland	3.21	2.00 to 2.50
San Francisco	3.50	2.35

Warehouse Prices on American Pig Lead

New York	4.75 to 5.75
Cleveland	5.00 to 5.25

Our Readers Ask

When writing directly to those whose names are given below, please send a copy of the data supplied to the Editor of PUBLIC WORKS, *310 East 45th St., New York, N. Y.*

• Experience and data on materials and methods for resurfacing old brick pavements and for covering street car tracks in brick paved streets is asked by A. T. ERNENWEIN, *City Engineer, Oneida, N. Y.*

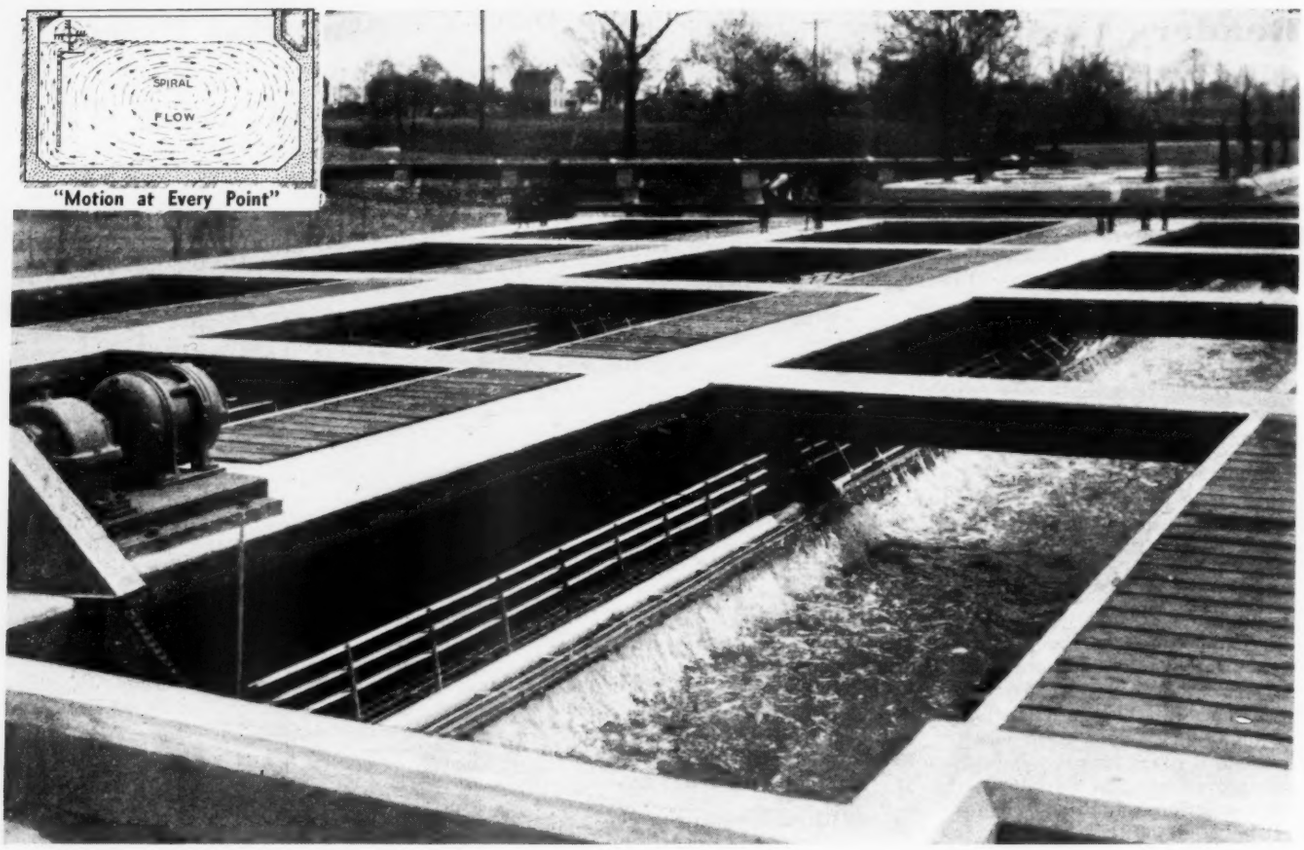
• Methods and equipment employed, and cost, of tunneling for small sewers and for utility lines, and the construction of deep sewers, has been asked for by several readers. Information on these types of work is requested from our readers, and will be forwarded promptly.

• ARTHUR SMALLEY, *City Engineer,* Hamilton, Ohio, requests information on the design and construction of an outdoor amphitheater, covering seating, bleachers, drainage, etc.

• About a dozen requests have been received for details of the design and construction of swimming pools, especially outdoor ones. Plans and descriptions of recent modern pools will be appreciated.

• Data on the cost of maintenance of calcium chloride treated gravel roads are requested by R. E. PATTERSON, *County Engineer,* Boone, Ia.

• Utilization of gas from sludge digestion tanks is of interest to GEORGE F. LIDDLE, *City Manager,* Muskegon Heights, Mich. PERRY T. NAYLOR, *City Engineer,* Hastings, Nebr., asks for data regarding gas collection methods and equipment.



"Motion at Every Point"

Air Costs Money

. . . when applied under pressure at the bottom of an activated sludge tank; money to install the motor and blower or compressor, the air piping and diffuser plates; and additional expense continuously thereafter to operate. The cost of delivering filtered air against hydrostatic pressure at the bottom of a deep tank, keeping the diffusers clean, and maintaining the motor-driven equipment, is considerable.

The greater part of the air so expensively delivered is used for mixing, rather than for supplying oxygen. Mixing of the air and returned activated sludge with the incoming sewage is very important—just as important as supplying oxygen. The more thorough the mixing, the less oxygen required, and the better the result. But more thorough mixing can be effected at less cost by other means than injecting air. We believe the Link-Belt STRAIGHTLINE Aerator is the best means available for this purpose.

The STRAIGHTLINE Aerator combines agitation with a spiral motion, the latter bringing every drop of the sewage to the revolving blades several times, as it flows through the tank, thus effecting complete mixing, besides spraying and agitating the surface so that every drop is given an opportunity to absorb all the oxygen it demands from the atmosphere. Experience has demonstrated that oxygen absorption so provided, meets all requirements of activation.

The STRAIGHTLINE Aerator is perhaps the simplest piece of mechanism used in modern sewage treatment—only a shaft carrying blades and revolved by a motor, the shaft and its roller bearings being located well above the sewage. No skilled mechanic is required to operate it, and there is practically nothing to get out of order or to clog. There are no "dead" spots in the tank where sludge can collect—all the tank contents are continuously in motion, at a velocity that can be varied to meet conditions. It is really simpler to operate than a plain digestion tank.

LINK-BELT COMPANY

PHILADELPHIA, 2045 West Hunting Park Avenue CHICAGO, 300 West Pershing Road
SAN FRANCISCO, 400 Paul Ave. TORONTO, Eastern Ave. & Leslie St. Offices in Principal Cities

4963

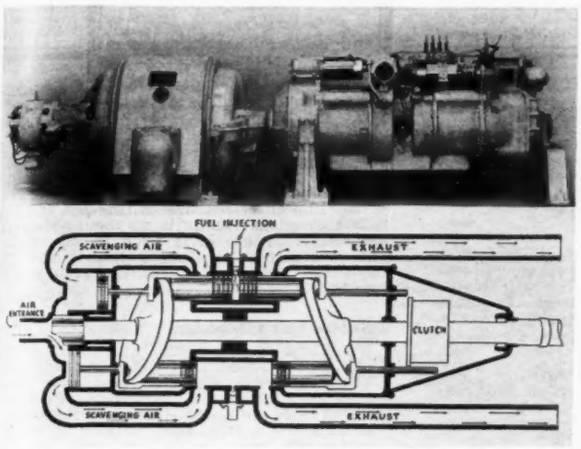
LINK-BELT

SCREENS ▲ COLLECTORS ▲ AERATORS ▲ GRIT CHAMBERS ▲ DISTRIBUTORS

Pages 53, 60 and 61 contain descriptions of many helpful booklets—Don't forget to look them over.

A Crankless, Valveless Diesel Engine

With a weight per horse-power of 13 to 20 pounds, without crankshafts, camshafts, cylinder heads and other parts that are generally considered necessary parts to any engine, the new Sterling diesel is considered to mark a new era in power utilization. Other features include compactness, low center of gravity, the ability to use a grade of fuel oil lower than is used for heating homes, and an estimated 75% saving in fuel costs over the ordinary gasoline engine.



The new Sterling Diesel above; interior view below

Reduced vibration and noise, along with the other improvements noted above, give this new engine a very wide commercial application.

In the municipal field it should have a wide application for operating electric generators, centrifugal pumps and air blowers where ordinary Diesels, gas or gasoline engines have heretofore served.

The smallest unit is shown in the accompanying illustation connected to a GE 80kw generator. The engine is built with either 4 or 6 horizontal cylinders each containing two opposed or reciprocating pistons, equivalent to a power plant of the conventional 8 or 12-cylinder type. It is of the 2-cycle type. Combustion is obtained by compressing air between the heads of each pair of opposed cylinders. Speed range is from 200 rpm up to as high as 1600 rpm in the smaller sizes. The CD-47 gives 625 hp on continuous service at 1200 rpm. The engine starts more positively than a gasoline engine, accelerates rapidly, and is very flexible.

This engine is built by the Sterling Engine Co., Buffalo, N. Y., under license from A. G. M. Mitchell, who developed thrust bearings for ocean liners. The power generated by the pistons is transferred to inclined disc, which are virtually fly-wheels. At present the engine is built in sizes up to 675 hp. A complete booklet describing it is available from the manufacturers or on request to the editor of this magazine.

• • •

Multiple Stage Sludge Digestion

Multiple stage sludge digestion—combining in one system the advantage of rapid mixing, digestion and gasification; a clear and harmless supernatant liquor; and adequate provision for sludge and gas storage—the Dorr Company's most recent development, is known as The Dorr Multdigestion system. The sectional drawing illustrates the mechanical features of this new equipment.

From 80 to 90 per cent of the sludge digestion takes place in a relatively small, heated, primary digester, equipped with a gas holder. Two or more totally-enclosed motors, mounted on the gas holder, drive high speed turbo mixers that serve to keep the sludge homogeneous and in rapid circulation.

The sludge and gas are automatically transferred from the primary digester to the secondary or storage tank, which is neither heated nor agitated, but is surmounted by a gas holder of any desired capacity.

A clear supernatant liquor is overflowed only from the secondary tank. This tank, being in a quiescent state, acts as a clarifier and sludge thickener. Thus the problem of disposing of a foul overflow is done away with and a heavier final sludge is secured.

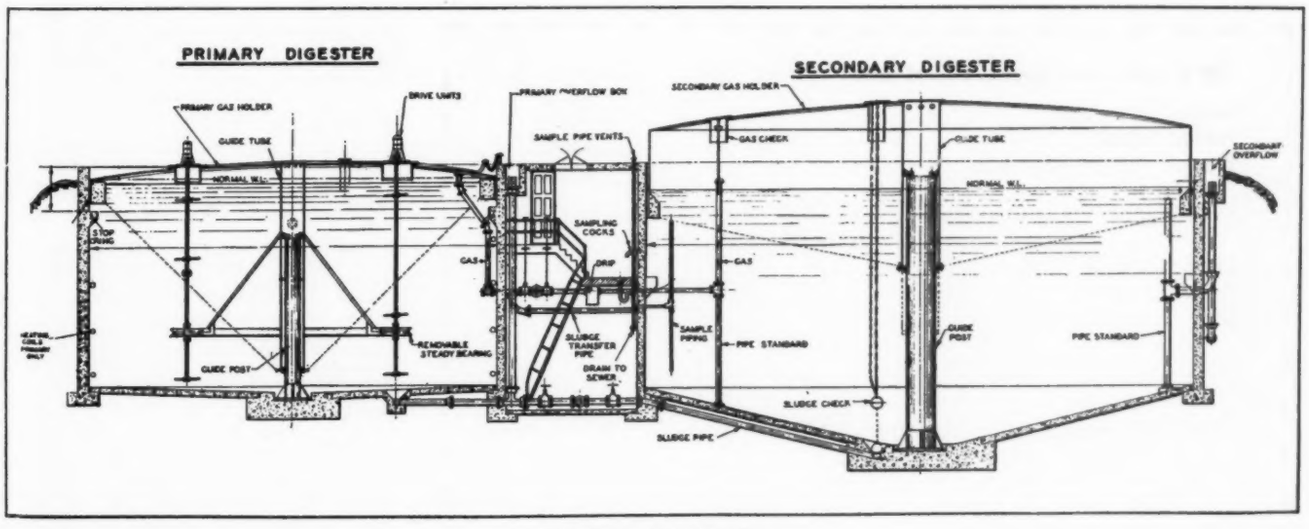
The extent of digestion in the primary practically halves the amount of solids going to the secondary. The total detention provided is the same as for single stage digestion, but the installed cost is less. Furthermore, scum formation is prevented.

The Dorr Multdigestion system is clean-cut, compact, and attractive in appearance. Cumbersome superstructures, separate gasometers and other unsightly auxiliaries have been eliminated, leaving exposed to the eye only the tops of the gas holders and the weather-proof motors.

• • •

Arc Welding:

An illustrated twenty-eight page bulletin describing welding equipment and applications of welding in the construction fields has been published by the Westinghouse Electric and Manufacturing Company. Many typical and outstanding construction jobs are shown. Copies of the publication may be obtained from the advertising department, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.



The Dorr Multdigester

Readers' Service Department

(Continued from page 53)

To help you in your work, any of this **INDUSTRIAL LITERATURE** will be sent **FREE** upon request.

IT is a good practice to check this list regularly because descriptions of new bulletins are always being added. ★

Construction Materials and Equipment

Asphalt Heaters

9. Illustrated manual No. 11 describes "Hotstuf," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance, roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Protective Coating

118. KRODEPROOF, the ideal protective coating for all structural surfaces subject to corrosion or contact with water is described in an 8-page bulletin recently issued by Lewis Asphalt Engineering Co., 30 Church St., New York, N. Y.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 61 Broadway, N. Y. C.

35. "A report on Current Practice of using Calcium Chloride for curing Concrete Pavements, Bridges, Culverts and Concrete Products." It includes reports from the Highway Research Board, the Bureau of Public Roads and State Highway Departments. Columbia Products Co., Barberton, Ohio.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size. The Jaeger Machine Company, Columbus, Ohio.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Galion Iron Works & Mfg. Co., E. Jeffry Mfg. Co., Columbus, Ohio.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts

Explosives

74. "Use of Explosives for Settling Highway Fills. A new booklet which fully explains by diagrams and charts the three methods developed after many tests by the Du Pont engineers, which singly or in combination will quickly and efficiently do your job. Just issued by E. I. Du Pont de Nemours & Co., Inc., Explosives Dept., Wilmington, Del.

Graders

76. Latest information about Galion Motor Patrol Graders, Road Maintainers and Leaning Wheel Graders with hydraulic control is contained in a new series of illustrated catalogs, Nos. 125, 130, 135 just issued by the Galion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio.

Hose and Belting

87. Complete information on rubber hose and belting for all types of contracting and road building service. The Government Sales Department of the Goodyear Tire & Rubber Co., Inc., Akron, Ohio.

Joint Filler and Line Marker

88. Bulletin No. G-9 issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describes and illustrates their new No. 91 Joint Filler which is used to fill horizontal and center joints with hot asphalt. It can be equipped to apply an asphaltic center line as it fills the center joint. This bulletin also describes the Littleford Traffic Line Marker.

Joint Filling Pot

39. A supplement to Bulletin No. E-5 has been issued by Littleford Bros., 452 E. Pearl St., Cincinnati, Ohio, describing their cone-shaped crack filling pot No. 86-B. The chief feature of this pot is that it is springless—there is no mechanism to get out of order. It is used to fill cracks and joints in concrete pavements and interstices in brick or granite block pavements.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1248, 1298 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia.

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Motor Trucks

105. Full information about their complete line of motor trucks, all powered by six-cylinder "truck-built" engines of uniform valve-in-head design, will be sent promptly. General Motors Truck Co., Pontiac, Mich.

106. "Trucks for Public Utilities," is a new illustrated booklet just issued by the International Harvester Co., 606 So. Michigan Ave., Chicago. Covers uses, types, special equipment, bodies and specifications. Sent free on request.

Paving Materials

108. "Emulsified Asphalts" is a 56-page manual covering Penetration Type Construction, Road and Plant Mixes Pavements, Surface Tratments and Maintenance Methods. Includes 58 illustrations. Sent free by Headley Asphalt Division, Sinclair Refining Co., P. O. Box 66, Marcus Hook, Penn.

226. "Asphalt Surfacing Materials for Low-Cost Roads" is a handy, 28-page booklet illustrating the many types of road surfaces which can be constructed with Texaco asphalt materials. Well illustrated and contains tables of amounts of stone, sand and asphalt required. Sent promptly by the Texas Company, 135 East 42nd St., New York, N. Y.

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Road Machinery

126. A new general reference catalog No. 1320 covering their entire line of equipment for every approved method of construction and maintenance has just been issued by Austin-Western Road Machinery Co., 400 No. Michigan Ave. No. A-5, Chicago, Ill. Profusely illustrated with action pictures showing each type of machine out on the job.

4-34

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See additional descriptions on page 53

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and straight and leaning wheel graders. Gallon Iron Works & Mfg. Co., Gallon, O.

Rollers

132. A 32-page book in four colors featuring a complete line of road rollers. 8¾ x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio.

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses.

134. "The Chief," a six cylinder roller of advanced design and construction is fully described in an illustrated catalog just issued by the Galion Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio. Gives complete details of the very latest development by this company.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

145. The Austin Badger, a new, fully convertible ⅝ yard crawler shovel, made by The Austin-Western Road Machinery Co., 400 North Michigan Ave., No. A5, Chicago, is fully described and illustrated in their Bulletin No. 1236.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines. 910 S. Mich. Ave.

Tires, Truck and Tractor

165. Speed and economy in use of solid, cushion and pneumatic tires and tubes for trucks, cars, tractors, graders and other road machinery. Government Sales Department of the Goodyear Tire & Rubber Company, Inc., Akron, Ohio.

Snow Removal

345. "Standard and Heavy Duty Reversible Blade Snow Plows for Motor Trucks," a new bulletin just published by the Monarch Mfg. Co., East Front St., Wilmington, Del. Illustrated. Contains complete descriptions and specifications.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow for trucks. Carl Frink, Mfr. of Clayton, N. Y.

359. Gallon Iron Works and Mfg. Co., Gallon, Ohio. Details, prices and catalogs of their snow plows adaptable to any make of truck.

Sanitary Engineering

Clarifying Tanks

383. Loughlin Clarifying Tanks for the more complete removal of suspended solids from sewage and industrial wastes at lower cost are described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

Sludge Drying

385. Relatively dry cake sludge in demand for fertilizer is produced by automatic continuous vacuum filters like those used in Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C. Write for literature. Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

Activation and Aeration

390. A booklet of value to sanitary and chemical engineers describes Norton Porous Mediums of bonded fused alumina (strong chemically stable, uniformly permeable) and their use in aeration of water and sewage. Norton Co., Worcester, Mass.

Glass Covers

393. Full details regarding the use of Lord & Burnham Glass-Overs at Middletown, N. Y.; Marion, Ohio; Cleveland, Ohio; Freeport, N. Y.; Kitchener, Canada; West Chester, Pa., and other places are given in bulletins 22 to 33. Sent promptly on request to Lord & Burnham Co., Irvington, N. Y.

Jointing Materials

402. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic, Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

419. An illustrated booklet showing installations, and complete details regarding the 19 exclusive improvements which are featured in Shevlin Fine Disc Screens will be sent promptly by the Shevlin Engineering Co., Inc., 227 Fulton St., New York, N. Y.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Conditioning

382. Full information concerning the experiences in the use of ferric chloride for use in sludge conditioning and in coagulating sewage will be sent promptly by Innis, Speiden & Co., 117 Liberty St., New York, N. Y.

Treatment

429. A new series of bulletins describing their full line of sewage treatment equipment—Fine Screens, Schofield Bar Screens, Vacuum Filters for Sewage Sludge, Decarie Screenings Incinerators, Schofield Bar and Fine Screens, Vacuum Filters for Sewage Filtration and Pneumatic Ejectors for Sewage Screenings—are ready for distribution on request to Municipal Sanitary Service Corp., Room 2703, 155 East 44th St., New York, N. Y.

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

431. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., and Philadelphia.

Index to Advertisements

For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

A Coordinated Highway System:

Highway expenditures, 1921-31, for capital investment, maintenance, equipment, interest and other items; highway receipts from taxes, motor vehicles, gasoline tax, federal aid and bonds; the use of highways; and the general development of our highway system, are all treated in the March issue of the *Index*, published by the New York Trust Co., 100 Broadway, N. Y. This article contains some interesting figures: The per capita mileage of passengers in passenger automobiles is some 12 times as great as the per capita passenger mileage on all the steam railroads. Reports on 5,000 active highway projects of all sorts in August, 1931, showed the following equipment in use: 2,150 power shovels; 1,175 cranes; 700 pavers; 1,750 mixers; 1,775 rollers; 5,450 tractors; and 24,500 trucks, to a total value, including other tools and equipment, of $160,000,000. This represents a good cross-section of public works activities.

New Type of Bridge:

In the construction of concrete bridges along the Canadian National Railway, new types of concrete bridges have been constructed. Among the interesting features is the laying of the rails directly on a thin oak strip embedded in the concrete of the deck, without ties or ballast. Both rigid frame, single span, and the continuous slab with center support have been used. Very shallow decks reduce clearances. These bridges were described by C. P. Disney, bridge engineer, Canadian National Railways, Toronto, Ont., Can., in a paper before the Western Society of Engineers. It is believed further information can be obtained from Mr. Disney direct. Inasmuch as these types involve grade crossing elimination work, they should be of interest to highway engineers.

Chlorination in Sewage Disposal:

The American Public Health Association announces the publication of the Report of its Committee on Sewage Disposal of the Public Health Engineering Section, presented at the Sixty-second Annual Meeting in Indianapolis, October 10, 1933. This is a detailed review of the use of chlorination in sewage treatment, in its various phases. It contains a brief resume of the history of chlorination, the methods of application, the theories of chlorination, the effect of chlorination upon raw sewage and various treated sewages. Particular stress is given to a study of the removal of B.O.D. and effect of chlorinated effluents upon the streams. The use of chlorination in the control of sewage treatment operations and its effect in reduction of odors is covered, as well as its effect upon sludge digestion. Its use in connection with large scale projects to protect bathing beaches and water supplies is also noted. Numerous, up-to-date references are given, with sufficient excerpts to indicate the results obtained by various authorities, and their conclusions. It should prove of interest to everyone who is interested in handling sewage and will be of value to those more particularly concerned with water supply as well. The report contains 52 pages, is bound in paper covers, and is free to members of the Public Health Engineeing Section of the Association. The cost to others is 75c per copy. These may be secured from the American Public Health Association, 50 West 50th Street, New York, N. Y.

A 53 Year Index to Journal of the A.W.W.A.

The American Water Works Association has prepared, under one cover, a complete index to cover 53 years of the Proceedings, the Journal and other Publications of the Association from the earliest issue (1881) through 1933. It is classified according to subject matter, and authorship. It is also cross indexed and thereby makes readily available reference to the voluminous but scattered information contained in the Association publications.

This index has been compiled under the direction of A. V. Ruggles, Assistant Secretary of the Association. It contains 200 pages and is bound in stiff buckram covers. The index has been printed in a limited edition for sale to members at $1.50—a price less than actual cost of production. To non-members the price is $2.50 per copy. Orders will be taken at the Association office at 29 West 39th Street, New York City, for filling on or about April 1st. A sufficient number of copies will be reserved for supplying foreign members.

Bound Volumes of NRA Codes

NRA Codes of Fair Competition approved under the National Industrial Recovery Act are being compiled in bound volumes and can be purchased through the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of $1.50 per volume.

The Codes are arranged in chronological order, with Amendments, Supplemental Codes, Executive Orders and Administrative Orders and, it is believed, will in this form facilitate the reference needs of industries and persons directly affected by code developments and be of value to all who are interested in following the progress of industrial codification.

Volumes One, Two and Three have just been published. The first volume runs from July 9, 1933 to October 11, 1933. The second is from October 12, 1933 to November 10, 1933 and the third covers November 11, 1933 to December 7, 1933. Subsequent volumes will be issued as they are prepared by the Code Record Section of the Recovery Administration.

Swimming Pools:

Ditmars, Greenfield and Klockner of the New Jersey Department of Health, traveled 18,000 miles examining the 560 bathing places in that state. Their findings are summarized in the February, 1934, issue of "Public Health News," which is issued by the Department of Health of the State of New Jersey, Trenton, N. J. Much valuable information; more in the complete report, when and if that is available.

Early Strength Concrete-Effect of Temperature:

At the Road Show in Chicago, in January, H. F. Clemmer, engineer of Materials, District of Columbia, delivered a paper on the effect of temperature on early strength concrete. This paper has been published by the American Road Builders' Association, National Press Bldg., Washington, D. C., and is available from them or from the Calcium Chloride Association, 2075 Penobscot Bldg., Detroit, Mich. It has especial reference to winter construction, and gives results of laboratory and field experiments and tests.

Culvert Handbook:

This 60-page booklet by Toncan Culvert Mfrs. Assn., Massillon, O., spends a lot of time telling why and wherefore Toncan iron, but it also contains, in the last 35 or 40 pages, a lot of quite valuable information on drainage, run-off, etc., and provides a number of handy tables and equivalents.

Beautiful Low-Cost Bridges:

An unusually interesting 6-page folder illustrating the use of Armco Multi-Plate for low-cost bridges has been issued by the Armco Culvert Mfrs. Assn., Middletown, O. This booklet does not give any data for design for strength, but it illustrates some very beautiful structures, using headwalls of local materials, or of concrete.

Electric Motor Lubrication:

In the March issue of *Lubrication*, published by the Texas Co., New York, is a 12-page article on electric motor lubrication. The data cover nearly all types and sizes of motors, with sections and cut-away views of many pieces of equipment. For those who have motors to care for, we recommend this article. Write PUBLIC WORKS for copies. No charge.